AD-A132 019 WIND-SPEED EXTREMES IN THE NORTHERN HEMISPHERE 30 THROUGH 60 KM(U) AIR FORCE GEOPHYSICS LAB HANSCOM AFB MA A J KANTOR ET AL. 02 FEB 83 AFGL-TR-83-0029 1/3

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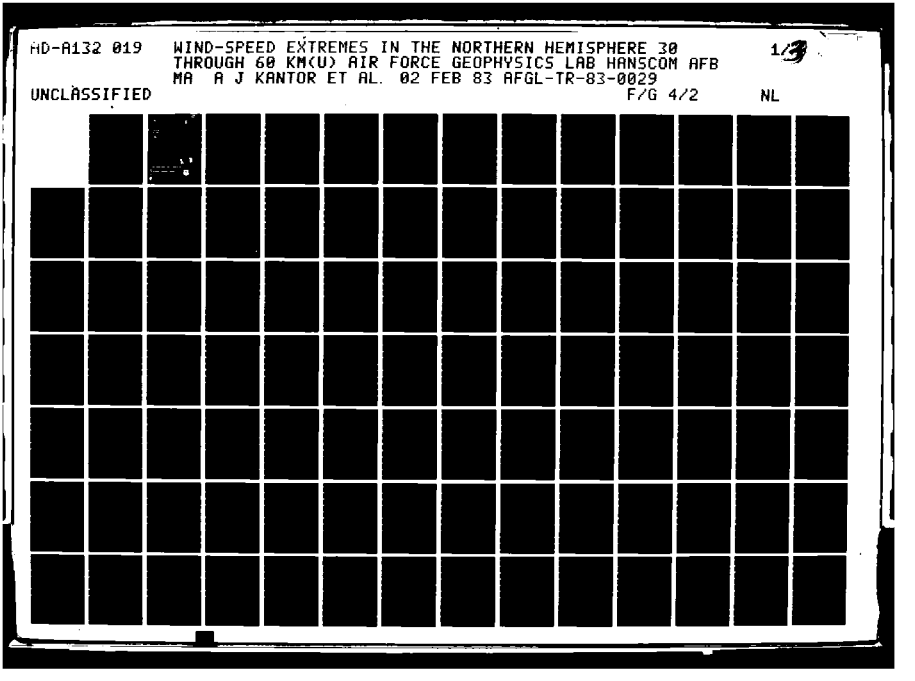

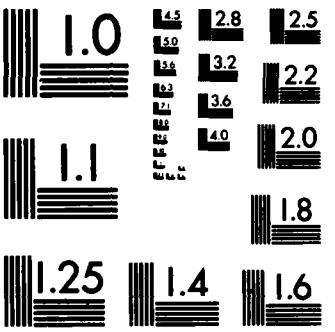

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AD A132019

Wind-Speed Extremes in the Northern Hemisphere, 30 Through 60 km

[illegible] J. KANTOR
[illegible] A. BARTON

2 February 1983

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[illegible] PROJECT 6670
AIR FORCE GEOPHYSICS LABORATORY
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AIR FORCE SYSTEMS COMMAND, USAF

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This technical report has been reviewed and is approved for publication.

Alva T Stair, Jr.

DR. ALVA T. STAIR, Jr
Chief Scientist

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER AFGL-TR-83-0029	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) WIND-SPEED EXTREMES IN THE NORTHERN HEMISPHERE, 30 THROUGH 60 KM		5. TYPE OF REPORT & PERIOD COVERED Scientific, Interim. 6. PERFORMING ORG. REPORT NUMBER ERP No. 823
7. AUTHOR(s) Arthur J. Kantor Eugene A. Bertoni		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Air Force Geophysics Laboratory (LY) Hanscom AFB Massachusetts 01731		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62101F 66700911
11. CONTROLLING OFFICE NAME AND ADDRESS Air Force Geophysics Laboratory (LY) Hanscom AFB Massachusetts 01731		12. REPORT DATE 2 February 1983 13. NUMBER OF PAGES 109
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Extreme winds
NH extreme winds
Stratospheric winds
Mesospheric winds

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides northern hemisphere maps of monthly 90-, 95-, and 99-percentile scalar speeds (10-, 5-, and 1-percent extremes) for altitudes 30 through 60 km. Observed meridional and zonal mean winds and their associated standard deviations were used to derive the magnitude of the mean monthly wind vectors and vector standard deviations. Extreme scalar speeds were then calculated from the magnitudes of the vector means and vector standard deviations, assuming a circular normal distribution. The data used to derive these values consist of wind measurements at and above 30 km from 8 years of data

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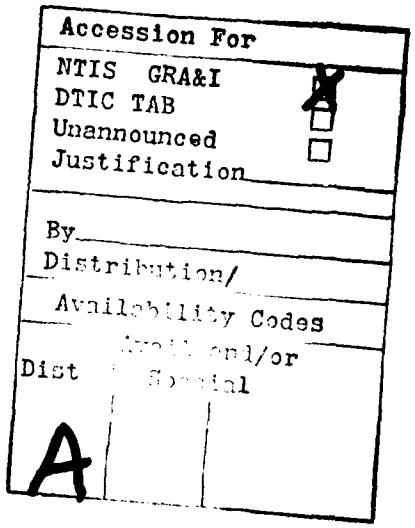
20. Abstract - Contd.

at 12 Meteorological Rocket Network (MRN) stations in the northern hemisphere. Also presented are tables of monthly and annual 10-, 5-, and 1-percent wind-speed extremes at each of the 12 MRN stations.

Preface

We wish to express our thanks to Mr. Thomas Weideman, Research Assistant, for his skillful programming and conversion of raw data to atmospheric extremes, and to Mrs. Helen Connell for her unselfish assistance in editing and typing of the text and tables. We also extend our thanks to Mrs. Cynthia Riccio who typed the final version of the tables.



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1. INTRODUCTION

Strong winds have been a potential meteorological problem for many decades. Not only do they affect aircraft, both in flight and on the ground, but in recent years, they have become important in missile and other aerospace vehicle design and operations. Extreme winds, for example, can be a significant factor during staging, that is, separation of a booster from its main vehicle on ascent, because flight control of aerodynamic vehicles may be lost temporarily during this maneuver.[1] In fact, specific extreme winds will be critical not only for design, but, in the operation of most aerospace systems, at some point during their lifetimes. These critical values will change depending upon the particular design of an individual vehicle or system.

Estimated 90-, 95-, and 99-percentile monthly wind-speeds (values that will be equalled or exceeded 10, 5, and 1 percent of the time during the month, respectively) are provided in this report for altitudes 30 through 60 km. The indicated wind-speed percentiles are presented on maps covering the western half of the northern hemisphere (centered on North and Central America), as well as in tables for 12 northern hemisphere locations.

(Received for publication 31 January 1983)

1. Sissenwine, N. (1968) Aerospace systems requirements for environmental data in the altitude range 60 to 200 km, Meteorol. Monographs 9(No.31):7-18.

2. OBSERVATIONS AND DATA LIMITATIONS

Data used to derive values given in this report consist of wind measurements at and above 30 km at 12 Meteorological Rocket Network (MRN) stations in the northern hemisphere for which some 8 years of observations were available. The sites, their geographic locations, and periods of record for which data were extracted are listed in Table 1.

Table 1. Observational Sites

Station	Location	Period of Record
Kwajalein	9°N, 168°E	Apr 1969 - Dec 1976
Fort Sherman	9°N, 80°W	Jan 1969 - Dec 1976
Antigua	17°N, 62°W	Jan 1969 - Dec 1976
Barking Sands	22°N, 160°W	Jan 1969 - Dec 1976
Cape Kennedy	28°N, 81°W	Jan 1969 - Dec 1976
White Sands	32°N, 106°W	Jan 1969 - Dec 1976
Point Mugu	34°N, 119°W	Jan 1969 - Dec 1976
Wallops Island	38°N, 75°W	Jan 1969 - Dec 1976
Primrose Lake	55°N, 110°W	Jan 1969 - Dec 1976
Fort Churchill	59°N, 94°W	Jan 1969 - Dec 1976
Poker Flats	65°N, 148°W	Jan 1969 - Dec 1976
Thule	77°N, 69°W	Jan 1969 - Dec 1976

Observations at the locations given in Table 1 were taken primarily with parachute-borne instruments launched by rockets. Root-mean-square (rms) observational errors for these sensors range from about 4 m/sec at 30 km to 8 or 9 m/sec at 60 km.[2] For the relatively few falling spheres that are included in the data set, rms errors range from 2 m/sec at 30 km to about 7 or 8 m/sec at 60 km.[2]

Monthly extremes of wind speed can be estimated from the monthly mean north/south (meridonal) and east/west (zonal) wind components and their standard

2. Meteorological Group, Range Commanders Council (1981) Meteorological Data Error Estimates, Document 110-81, White Sands Missile Range, N. Mex.

deviations due to day-to-day variations. These monthly means and standard deviations were obtained directly from the MRN observations for the stations listed in Table 1.[3] The observed rms variations (σ_o) around the monthly means include both the true rms variability (σ_t) due to changing synoptic conditions and the rms observational error (σ_e). If the true variability and observation errors are independent, the observed rms variability is given by Eq. (1)

$$\sigma_o = \left(\sigma_t^2 + \sigma_e^2\right)^{1/2} \quad . \tag{1}$$

The effect of observational errors should be carefully evaluated to determine how much of the variability indicated by the uncorrected soundings is due to synoptic changes in weather patterns. For an rms observational error of 8 m/sec (60 km), use of the true variability would result in a decrease in the estimated 1-percent extreme speed of only 4 m/sec out of 150 m/sec, less than a 3-percent reduction.

These observational errors have an even smaller effect on the mean monthly wind components because the rms observational error of the mean monthly wind is equal to the rms value of the error of an observation divided by the square root of the number of independent observations used in computing the monthly means. Day-to-day correlation, however, does reduce the effective number of independent observations, contributing somewhat to the uncertainty of the monthly means.

3. TECHNIQUE

The objective of this investigation is to provide the best estimate of wind-speed extremes over the northern hemisphere at altitudes above 30 km. Envelopes of the 10-, 5-, and 1-percent extremes are already available in MIL-STD-210B, Climatic Extremes for Military Equipment, for altitudes between the surface and 80 km. These values, however, are related only to the windiest months and locations in the world.[4] They represent global extremes and are unrelated in time and space; that is, wind speeds at one altitude may be valid for different locations and/or for different months than those at other altitudes. For this report, the estimated 10-, 5-, and 1-percent wind-speed extremes are presented on maps (covering the western half of the northern hemisphere) for 5-km altitude

3. World Data Center A (1969-1976) Data Report Meteorological Rocket Network Firings, NCC, Asheville, N.C.

4. DoD (1973) Climatic Extremes for Military Equipment, MIL-STD-210B, Washington, D.C.

increments from 30 through 60 km. These estimates, for the midseason months of January, April, July, and October, are provided on 84 maps in Appendix A. Tables also are presented in Appendix B, containing the magnitudes of the vector means and vector standard deviations as well as the annual and monthly 10-, 5-, and 1-percent extremes at each location. It should be noted that the 1-percent annual extreme could be the 5- or 10-percent extreme of the windiest month.

The observed meridional and zonal means and standard deviations described in Section 2 of this report were used to derive the magnitude of the mean monthly wind vectors and vector standard deviations for each level at each of the 12 MRN stations listed in Table 1. Extreme scalar speeds were then calculated from magnitudes of the vector means and associated vector standard deviations, assuming a circular normal distribution. The following formula was used for calculation of the 10-, 5-, and 1-percent extremes:[5]

$$P(c) = e^{-y} \sum_{n=o}^{\infty} \frac{y^n}{n!} \left[1 - e \sum_{m=o}^{n} \frac{x^m}{m!}\right] , \qquad (2)$$

where $y = \frac{D^2}{2\sigma^2}$ and D is the vector mean, $x = \frac{R^2}{2\sigma^2}$ and R is the scalar mean, and $2\sigma^2 = \sigma_v^2$ (that is, the square of the standard vector deviation). A circular normal distribution requires an assumption that the zonal and meridional wind components are uncorrelated (independent) and that their standard deviations are equal. Because the standard deviations around the mean monthly zonal winds are generally larger than the standard deviations around the mean monthly meridional winds, an elliptical normal rather than a circular normal distribution applies. The effect of this inequality in the standard deviations can be estimated. For example, when the standard deviation of one component is twice that of the other, a circle of radius equal to one vector standard deviation contains about 65 percent of the total probability rather than 63.2 percent when the standard deviations are equal (circular normal).[6] Because of this small difference, a circular normal approximation has been used in this report as it provides reasonably accurate estimates and simplifies the calculations that must be made to determine extreme winds in the stratosphere and lower mesosphere.

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5. Bell Aircraft Corporation (1956) Table of Circular Normal Probabilities, Rpt. No. 02 949-106.

6. Court, A. (1957) Maximum Variability Level of Winds, Scientific Report No. 2, Contract AF19(604-2060), AFCRC-TN-57-478, AD 117238.

4. RESULTS

Vertical cross-sections of mean monthly zonal and meridional winds have revealed that the strongest monthly vector winds occur in the middle latitudes, generally during the winter months.[7] The resulting hemispheric 1-percent scalar extremes have been estimated to reach 215 m sec^{-1} near 55 km.[4, 7]

Mean monthly vector winds for this report were calculated from monthly component winds and were found to be largest during winter between latitudes 30^{o}N and 60^{o}N. The 10-, 5-, and 1-percent extreme scalar speeds were estimated, for the 12 MRN locations shown in Table 1, using the statistical technique outlined in Section 3 of this report. The 10-, 5-, and 1-percent monthly and annual scalar extremes at these locations are listed in Tables B1 through B12. The largest 1-percent extreme, 154 m/sec, is shown at Primrose Lake (Table B9) in February at 50 km, an altitude typical of an extreme speed at a high-latitude location. The 1-percent extreme at Wallops Island (Table B8), 150 m/sec, appears in December at 60 km, with the maximum value probably occurring at or slightly above 60 km. At Point Mugu (Table B7), the 1-percent speed is 147 m/sec at 60 km in December. Extreme speeds are smaller at lower latitudes, as indicated in the tables for locations south of 30^{o}N.

The maps (see Appendix A) reflect the tabular values; they verify that the largest scalar extremes occur in winter. The wind-speed extremes increase with altitude up to about 50 km in high and upper middle latitudes, whereas they apparently increase up to at least 60 km at other latitudes. The summer extremes are somewhat less intense than those in winter; values are generally weaker over northern regions and near the equator than over the middle latitudes. April and October, or spring and fall, are normally transition months between the westerly winds of winter and the easterly winds of summer. Consequently, they display weaker scalar extremes than those in winter at most latitudes and altitudes.

5. SUMMARY

Estimates of 10-, 5-, and 1-percent scalar wind-speed extremes are provided in this report for the western half of the northern hemisphere at altitudes 30 through 60 km. The map results, however, must be considered only as rough estimates because they are based on a sample limited to 12 widely-scattered locations, mostly in North and Central America. Although 1-percent extremes

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7. Kantor, A.J. (1969) Strong Wind and Vertical Wind Shear Above 30 Km, AFCRL-69-0346, AD 696598.

at the individual stations reach a maximum of only 154 m/sec between 50 and 60 km during the winter months, the maps suggest values up to at least 180 m/sec in January. Even stronger extremes may occur in December or February, as indicated by the monthly values in the tables. Earlier estimates, which were related to the windiest months and locations, indicate a hemispheric 1-percent extreme of 215 m/sec near 55 km.

References

1. Sissenwine, N. (1968) Aerospace systems requirements for environmental data in the altitude range 60 to 200 km, Meteorol. Monographs 9(No. 31):7-18.
2. Meteorological Group, Range Commanders Council (1981) Meteorological Data Error Estimates, Document 110-81, White Sands Missile Range, N. Mex.
3. World Data Center A (1969-1976) Data Report Meteorological Rocket Network Firings, NCC, Asheville, N.C.
4. DoD (1973) Climatic Extremes for Military Equipment, MIL-STD-210B, Washington, D.C.
5. Bell Aircraft Corporation (1956) Table of Circular Normal Probabilities, Rpt. No. 02-949-106.
6. Court, A. (1957) Maximum Variability Level of Winds, Scientific Report No. 2, Contract AF19(604-2060), AFCRC-TN-57-478, AD 117238.
7. Kantor, A.J. (1969) Strong Wind and Vertical Wind Shear Above 30 Km, AFCRL-69-0346, AD 696598.

Appendix A

Maps of 10-, 5-, and 1-percent Wind-Speed Extremes

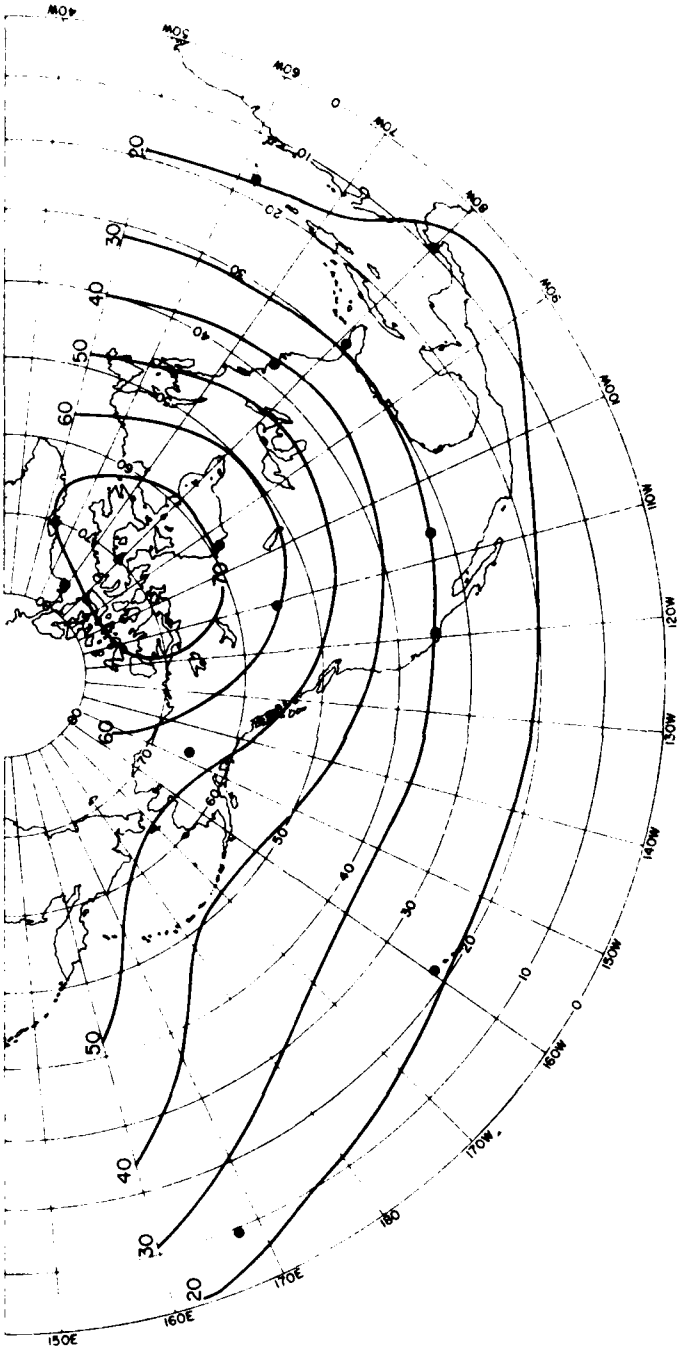

Figure A1. Scalar Speed (m/sec) at 30 km in January, 10-percent Extreme

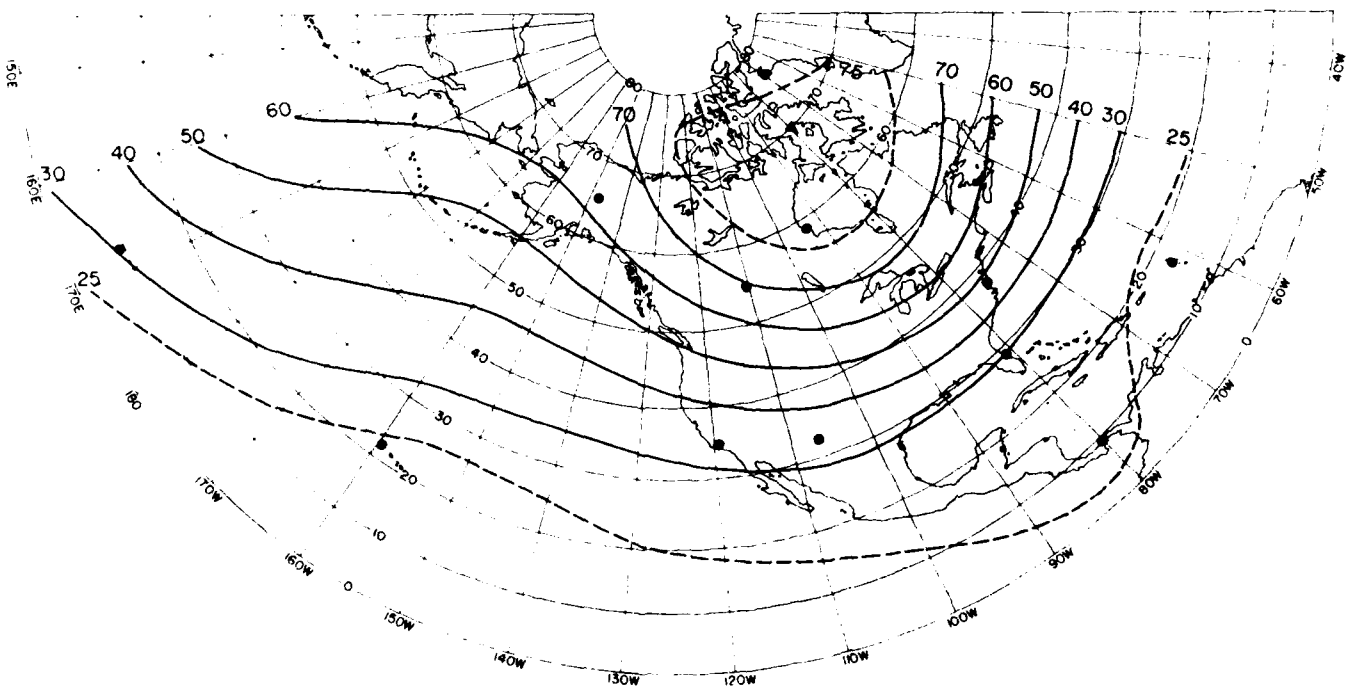

Figure A2. Scalar Speed (m/sec) at 30 km in January, 5-percent Extreme

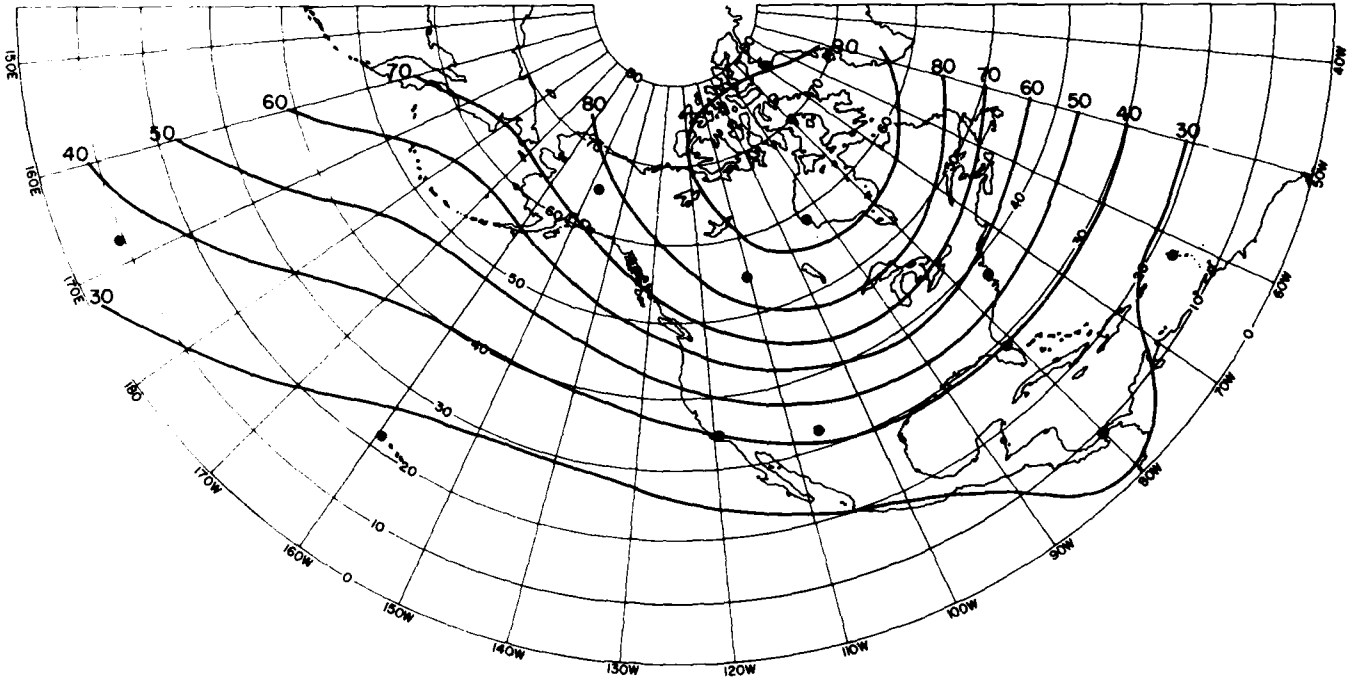

Figure A3. Scalar Speed (m/sec) at 30 km in January, 1-percent Extreme

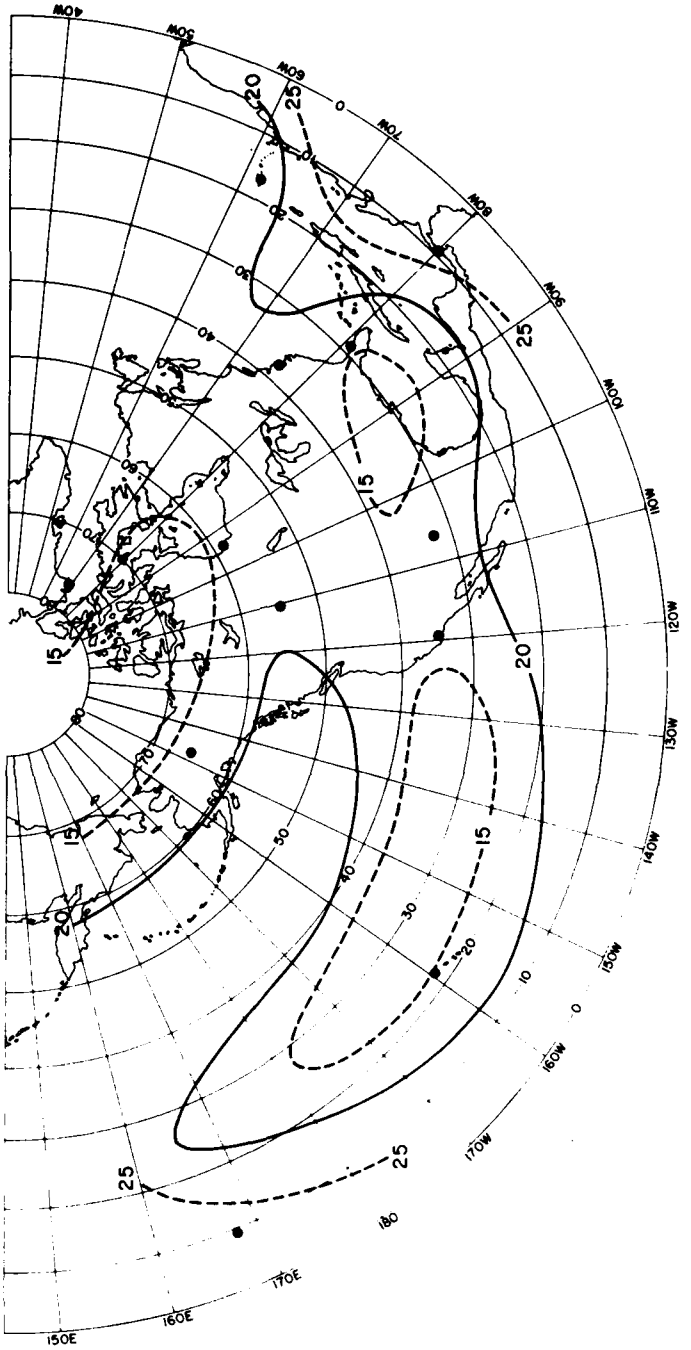

Figure A4. Scalar Speed (m/sec) at 30 km in April, 10-percent Extreme

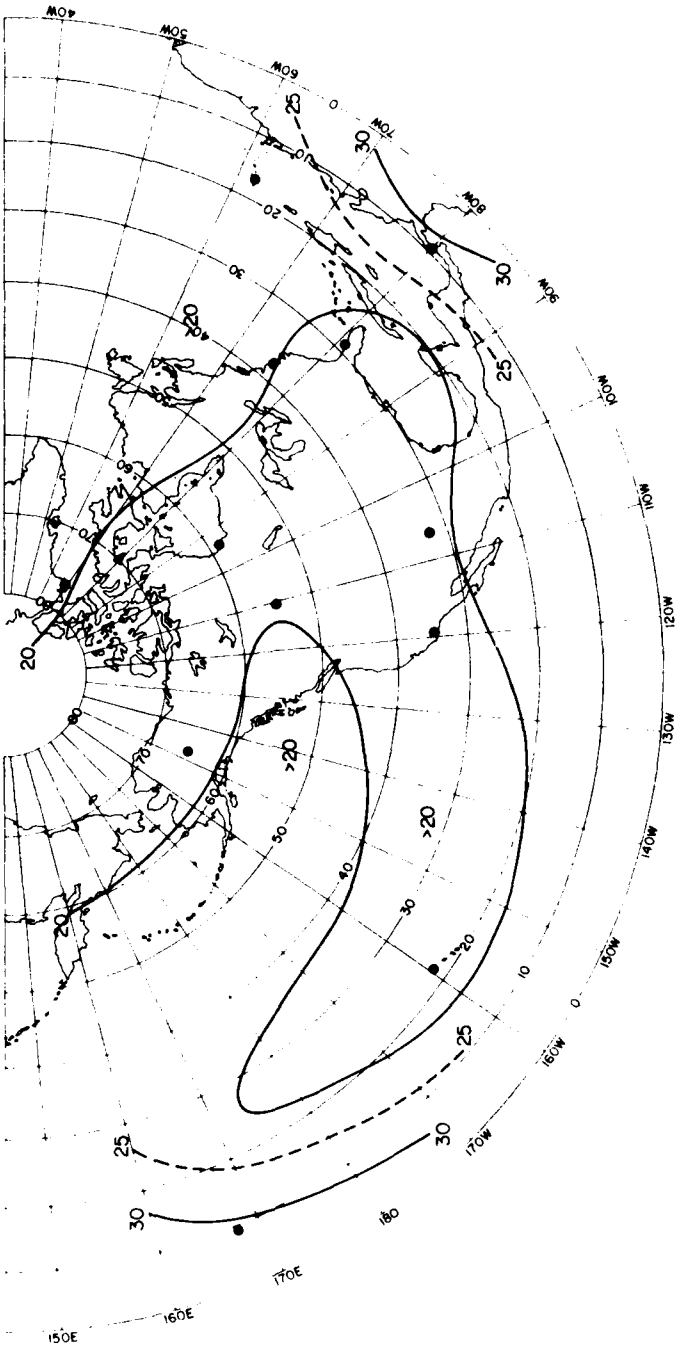

Figure A5. Scalar Speed (m/sec) at 30 km in April, 5-percent Extreme

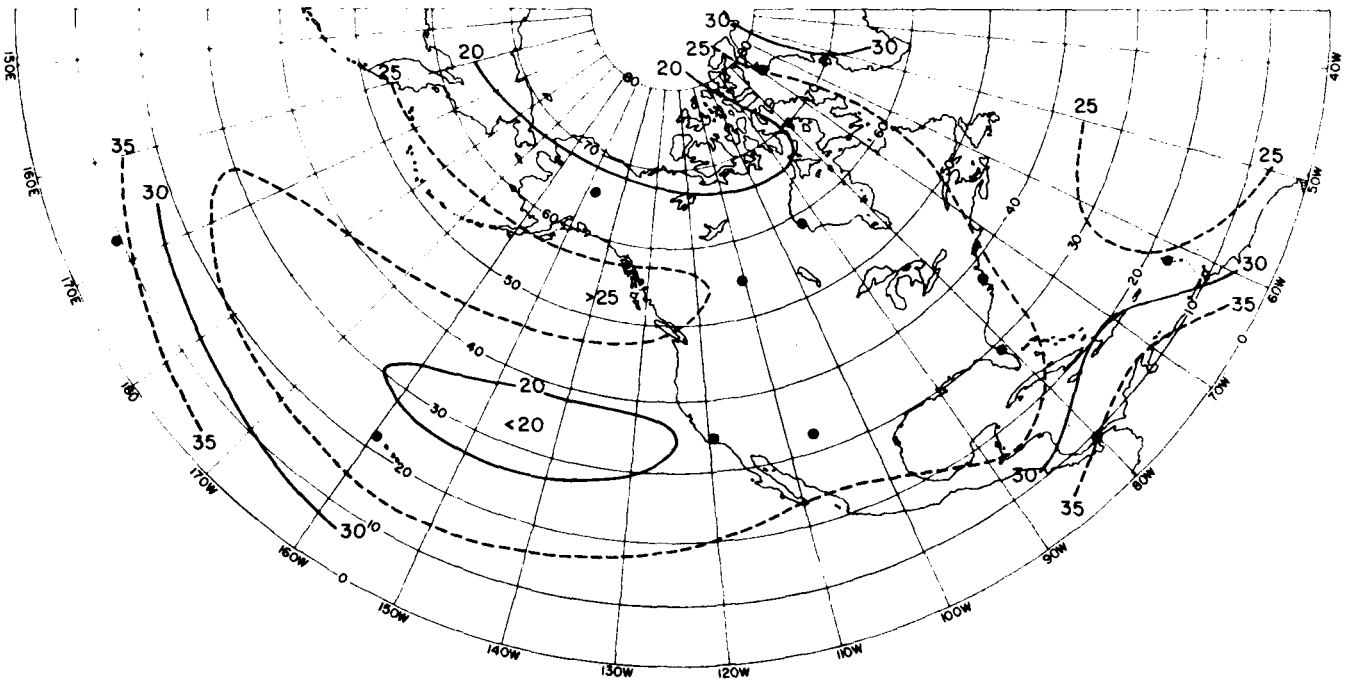

Figure A6. Scalar Speed (m/sec) at 30 km in April, 1-percent Extreme

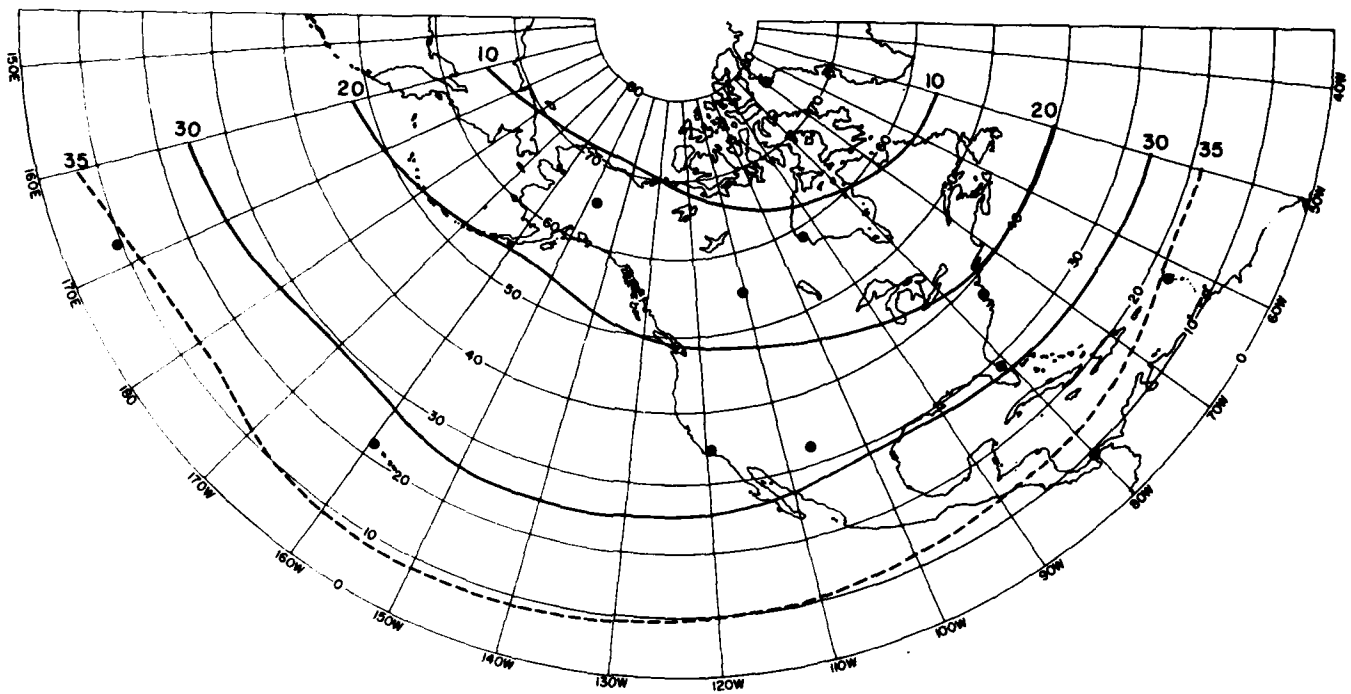

Figure A7. Scalar Speed (m/sec) at 30 km in July, 10-percent Extreme

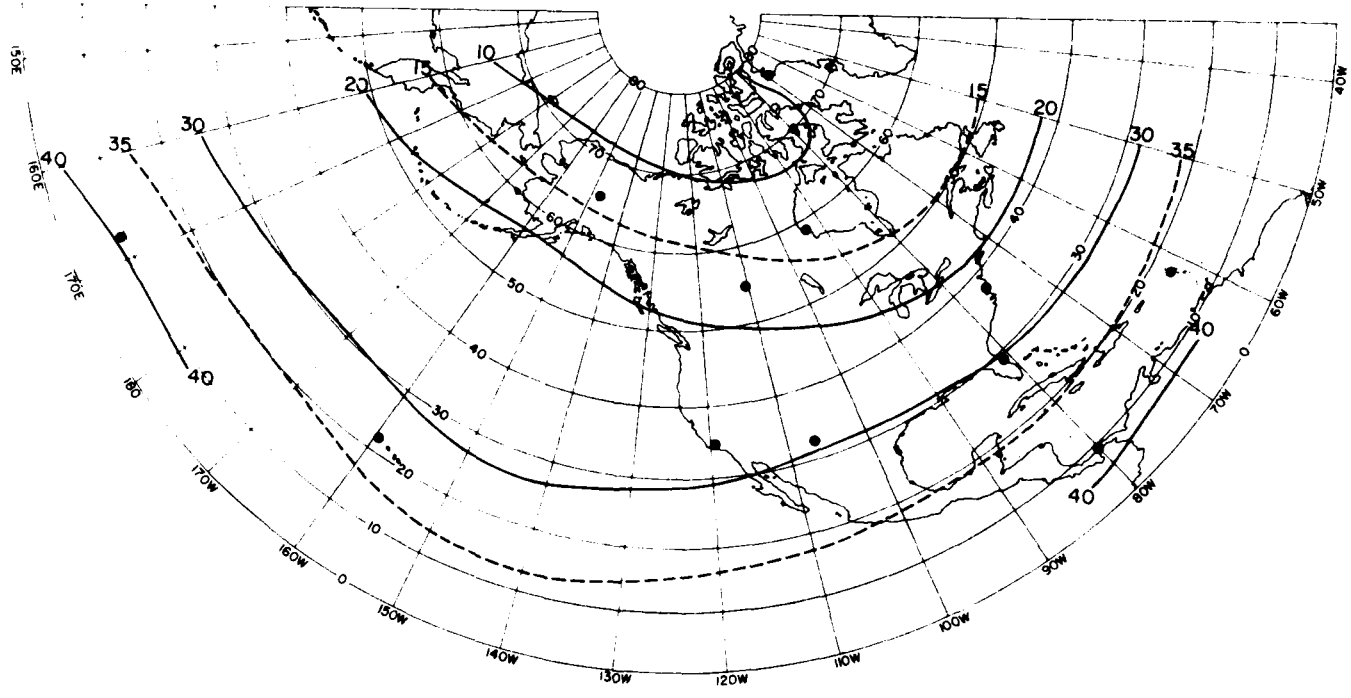

Figure A8. Scalar Speed (m/sec) at 30 km in July, 5-percent Extreme

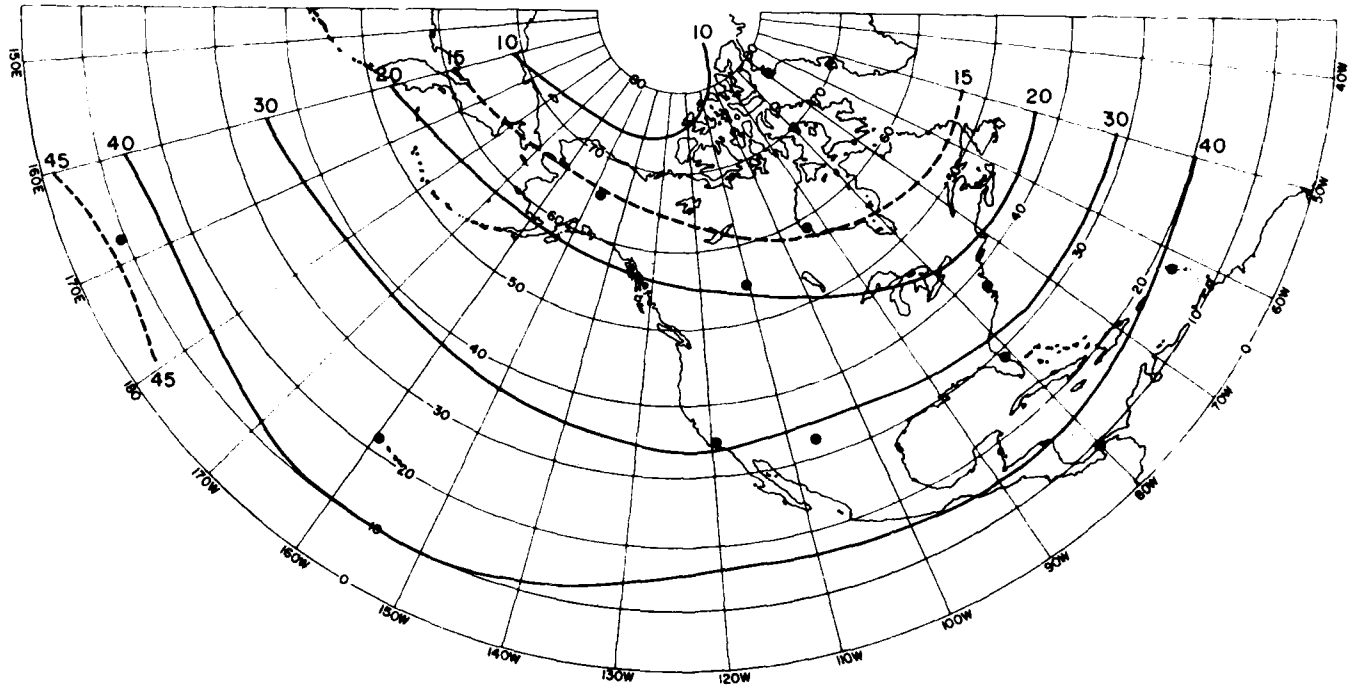

Figure A9. Scalar Speed (m/sec) at 30 km in July, 1-percent Extreme

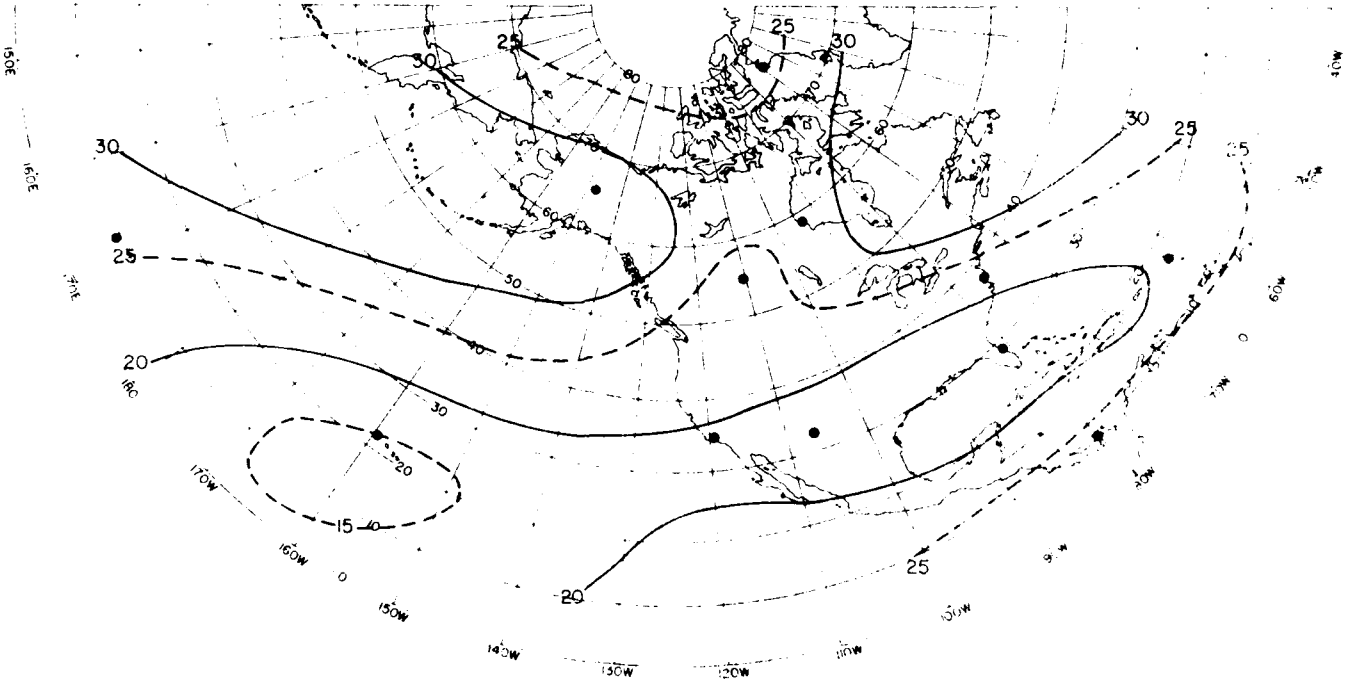

Figure A10. Scalar Speed (m/sec) at 30 km in October, 10-percent [illegible]

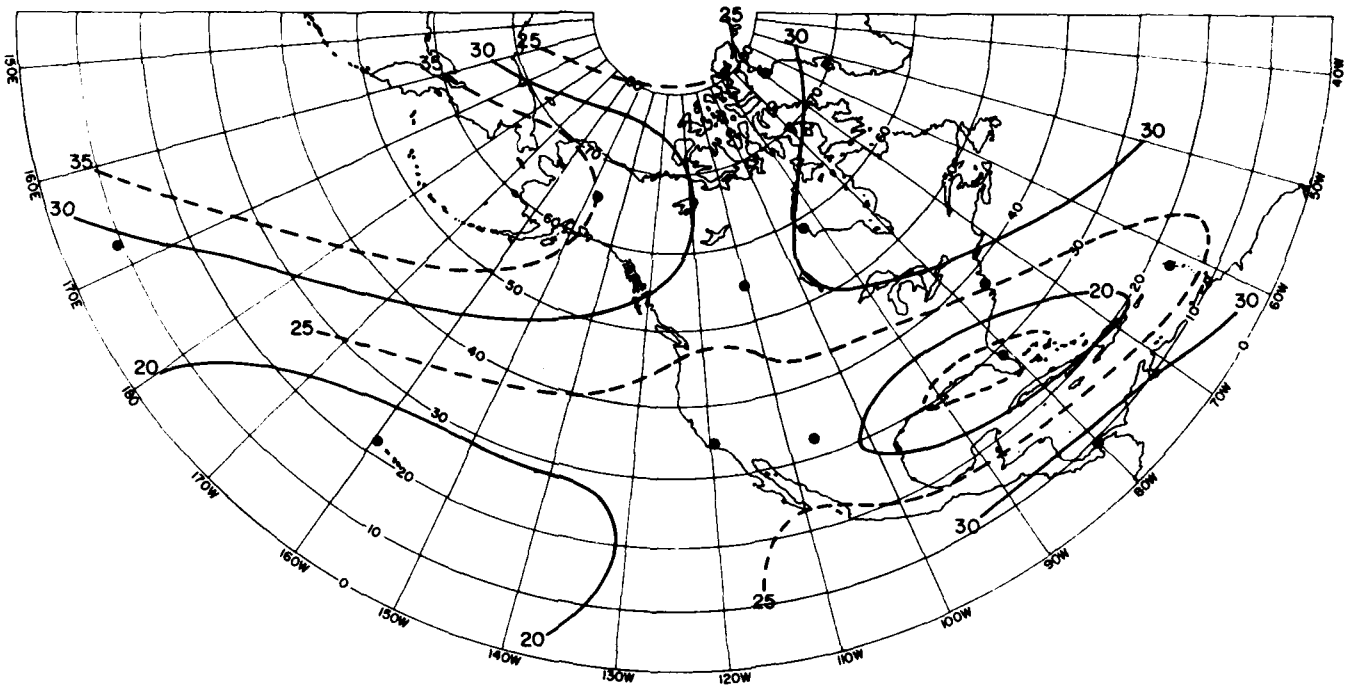

Figure A11. Scalar Speed (m/sec) at 30 km in October, 5-percent Extreme

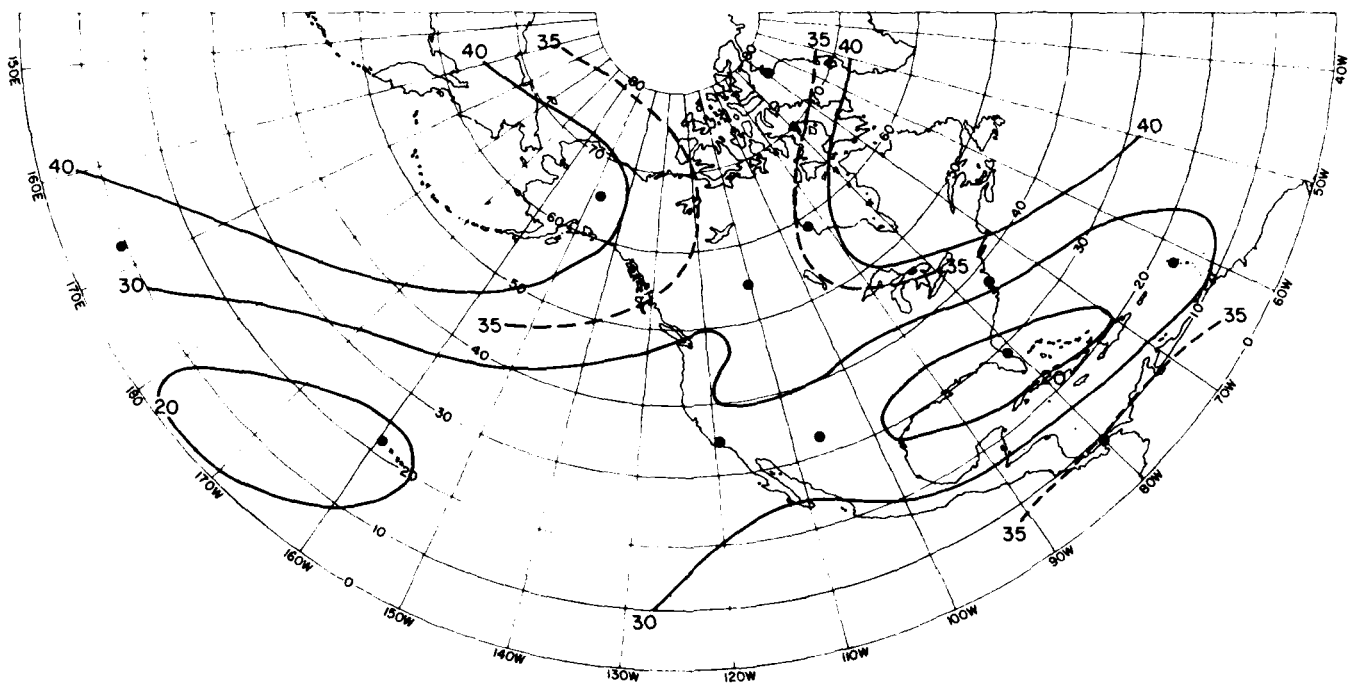

Figure A12. Scalar Speed (m/sec) at 30 km in October, 1-percent Extreme

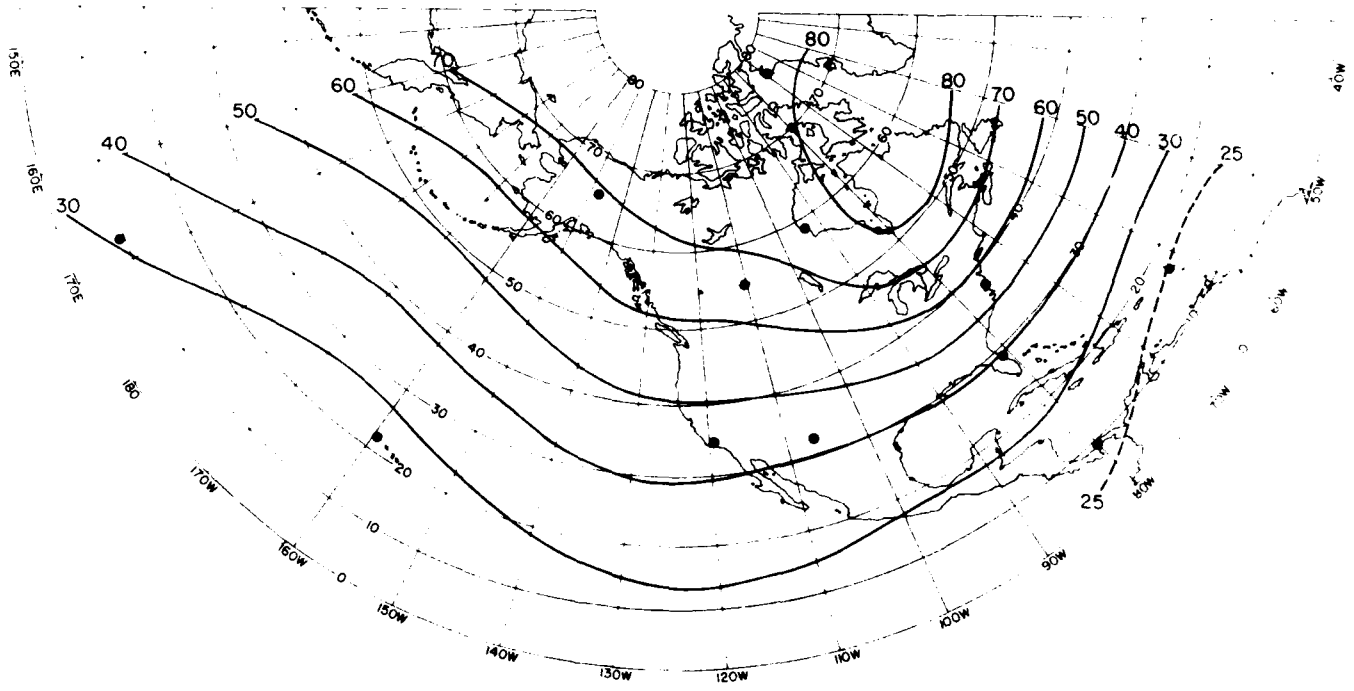

Figure A13. Scalar Speed (m/sec) at 35 km in January, 10-percent Extreme

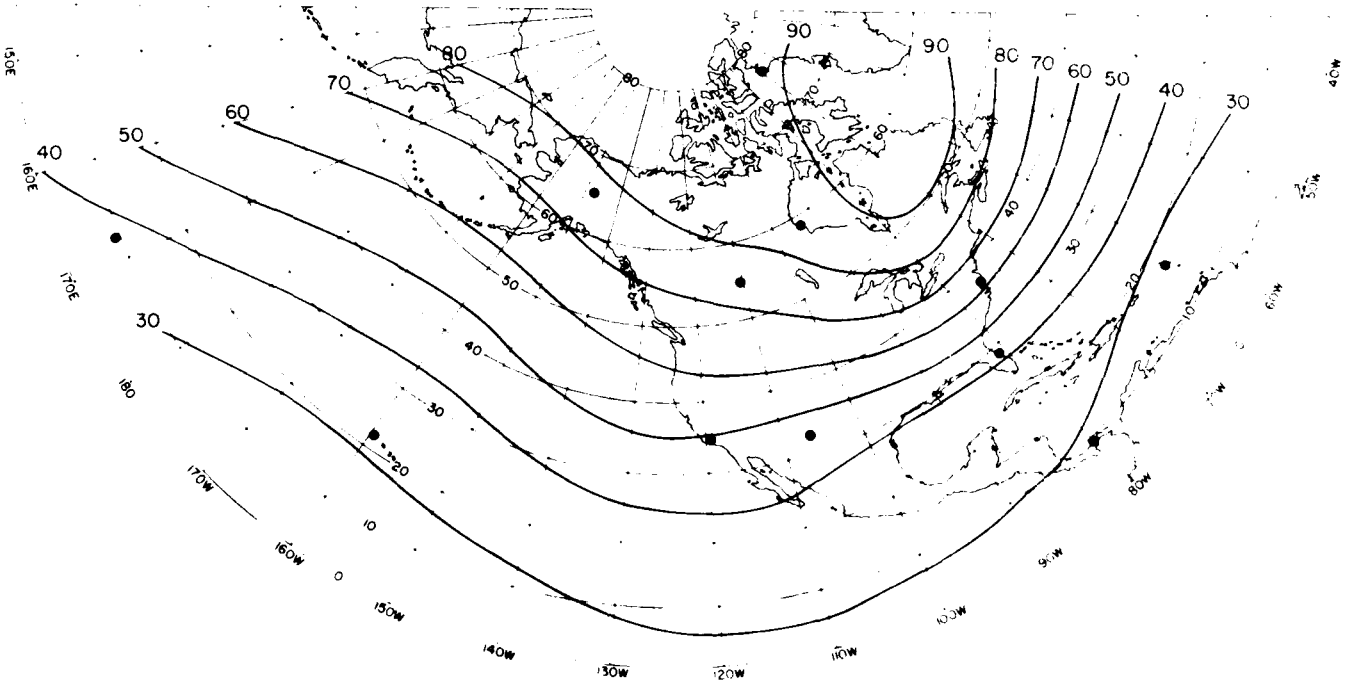

Figure A14. Scalar Speed (m/sec) at 35 km in January, 5-percent Extreme

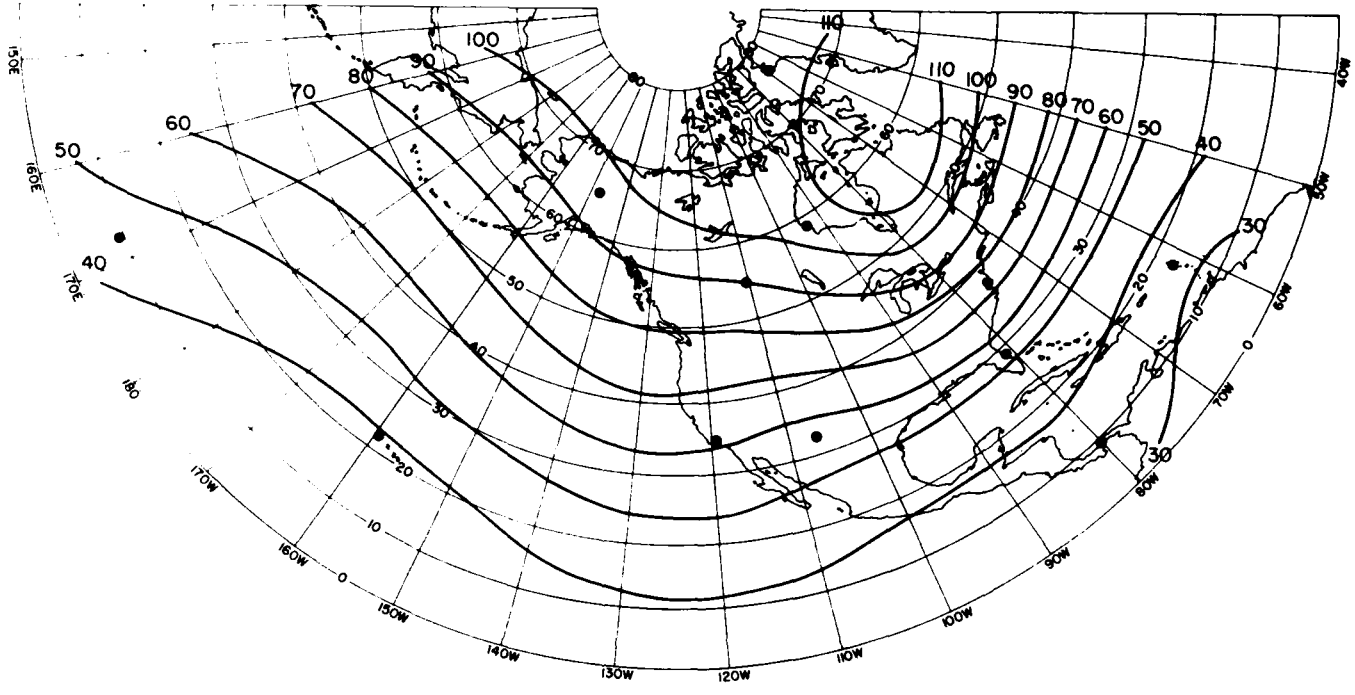

Figure A15. Scalar Speed (m/sec) at 35 km in January, 1-percent Extreme

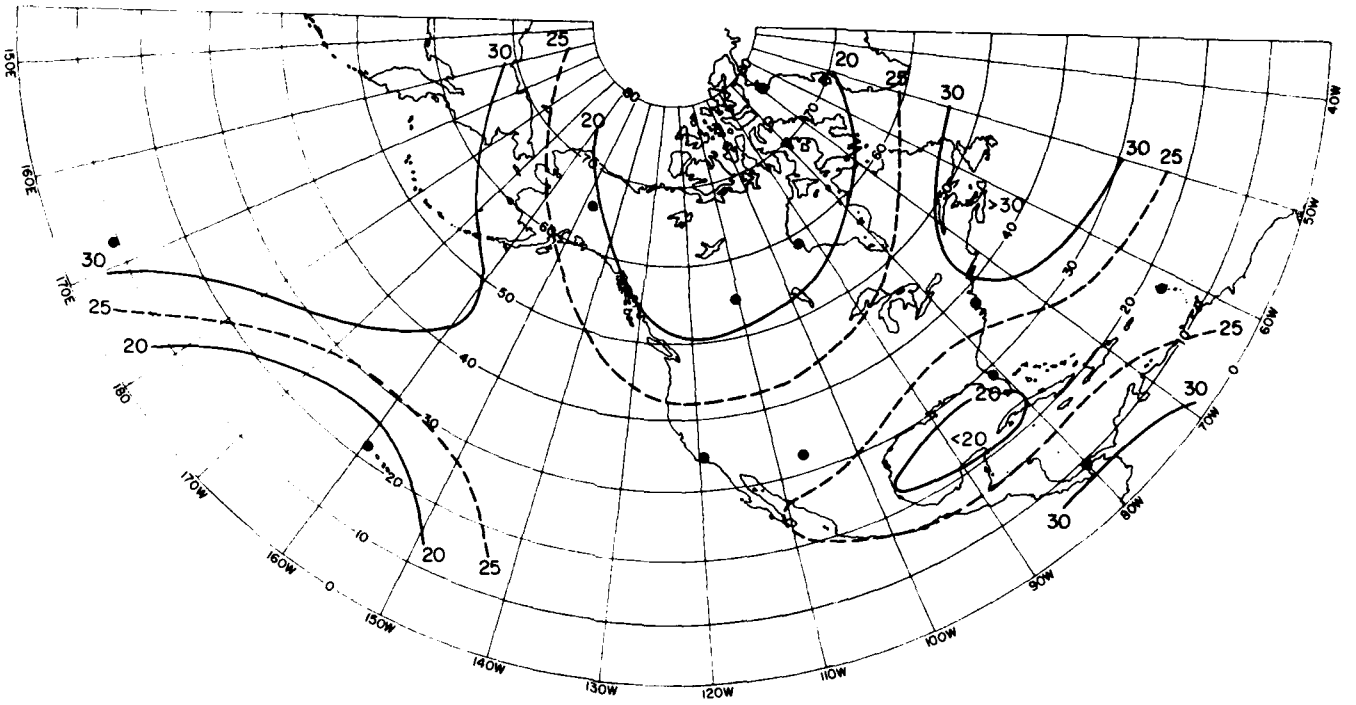

Figure A16. Scalar Speed (m/sec) at 35 km in April, 10-percent Extreme

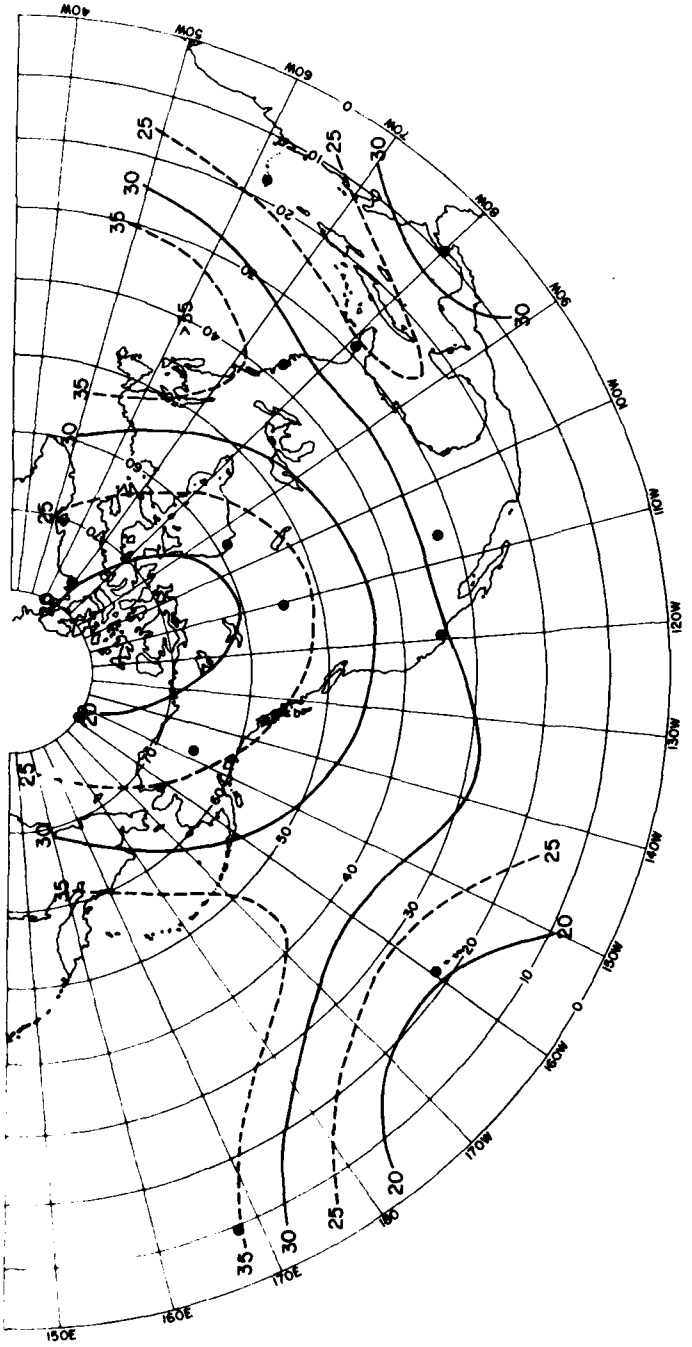

Figure A17. Scalar Speed (m/sec) at 35 km in April, 5-percent Extreme

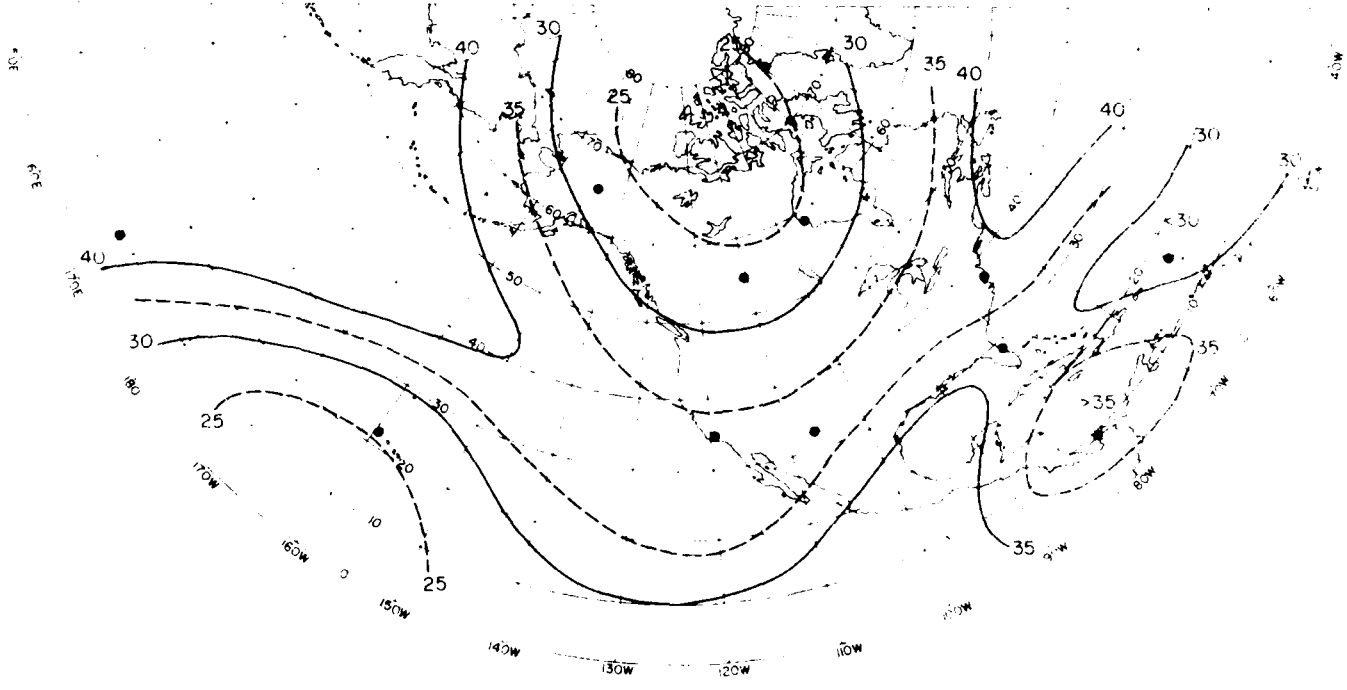

Figure A18. Scalar Speed (m/sec) at 35 km in April, 1-percent Extreme

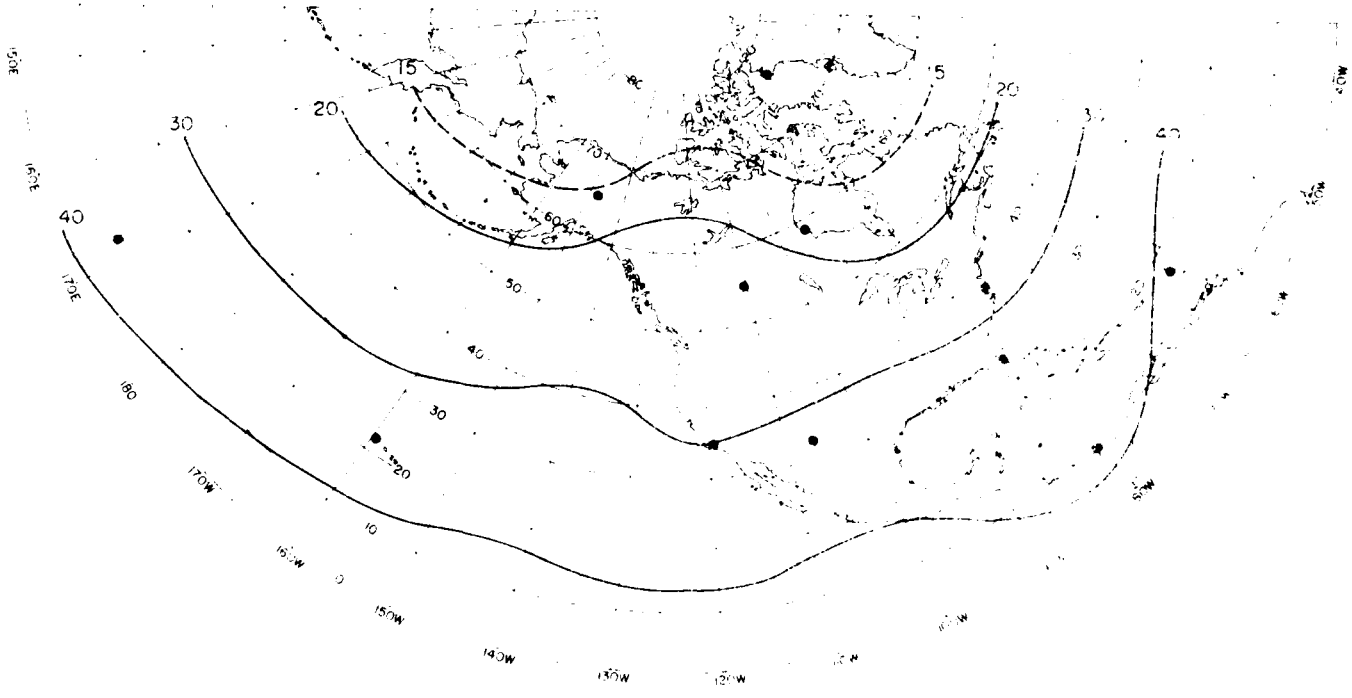

Figure A19. Scalar Speed (m/sec) at 35 km in July, 10-percent Extreme

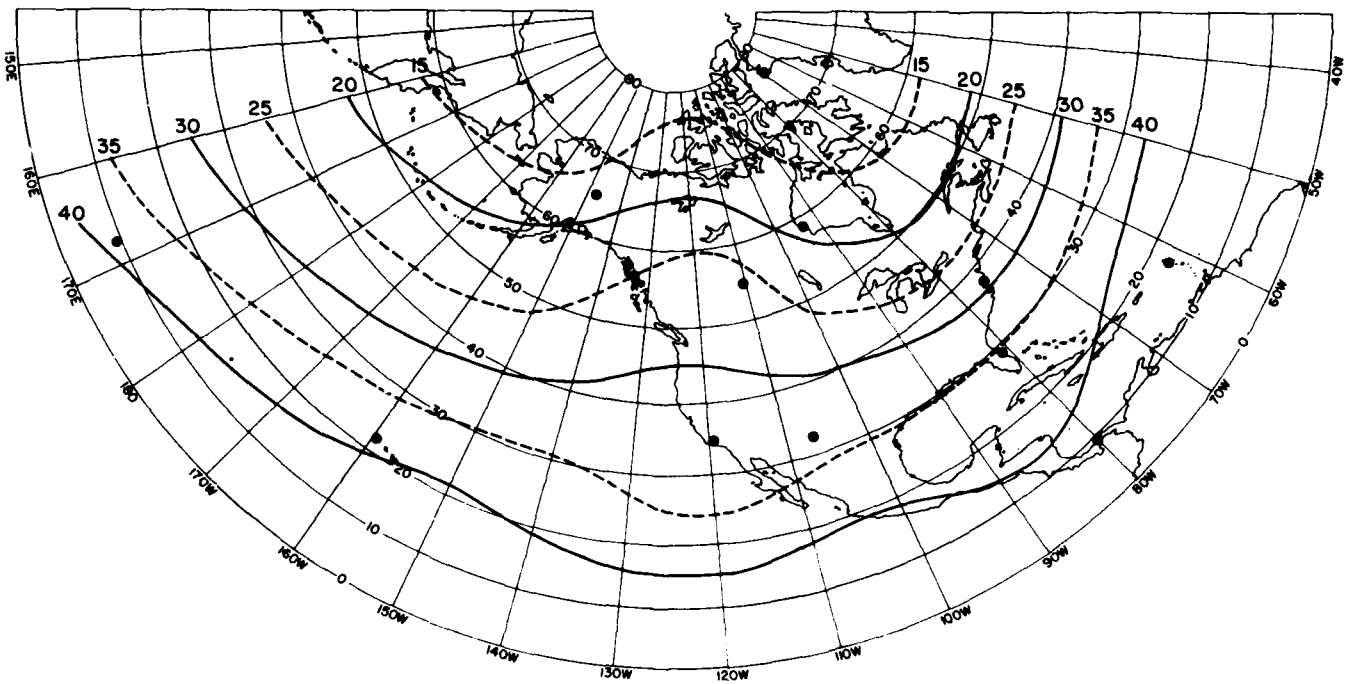

Figure A20. Scalar Speed (m/sec) at 35 km in July, 5-percent Extreme

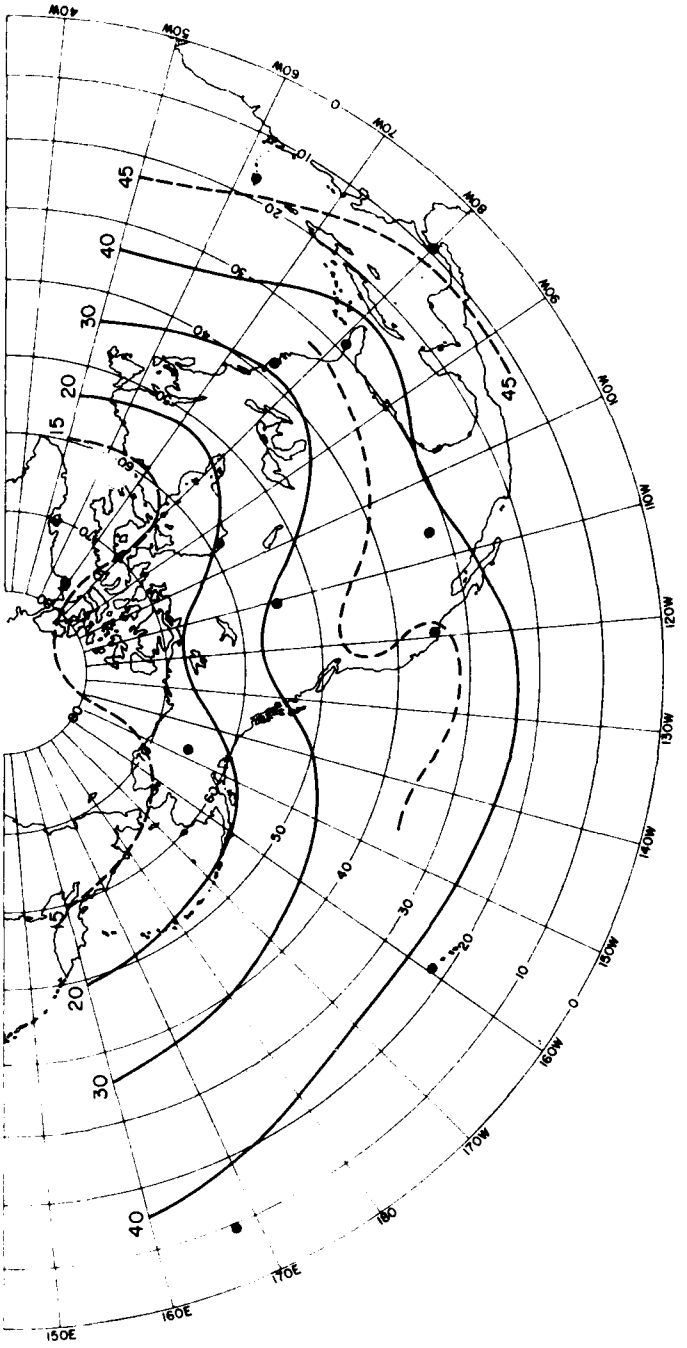

Figure A21. Scalar Speed (m/sec) at 35 km in July, 1-percent Extreme

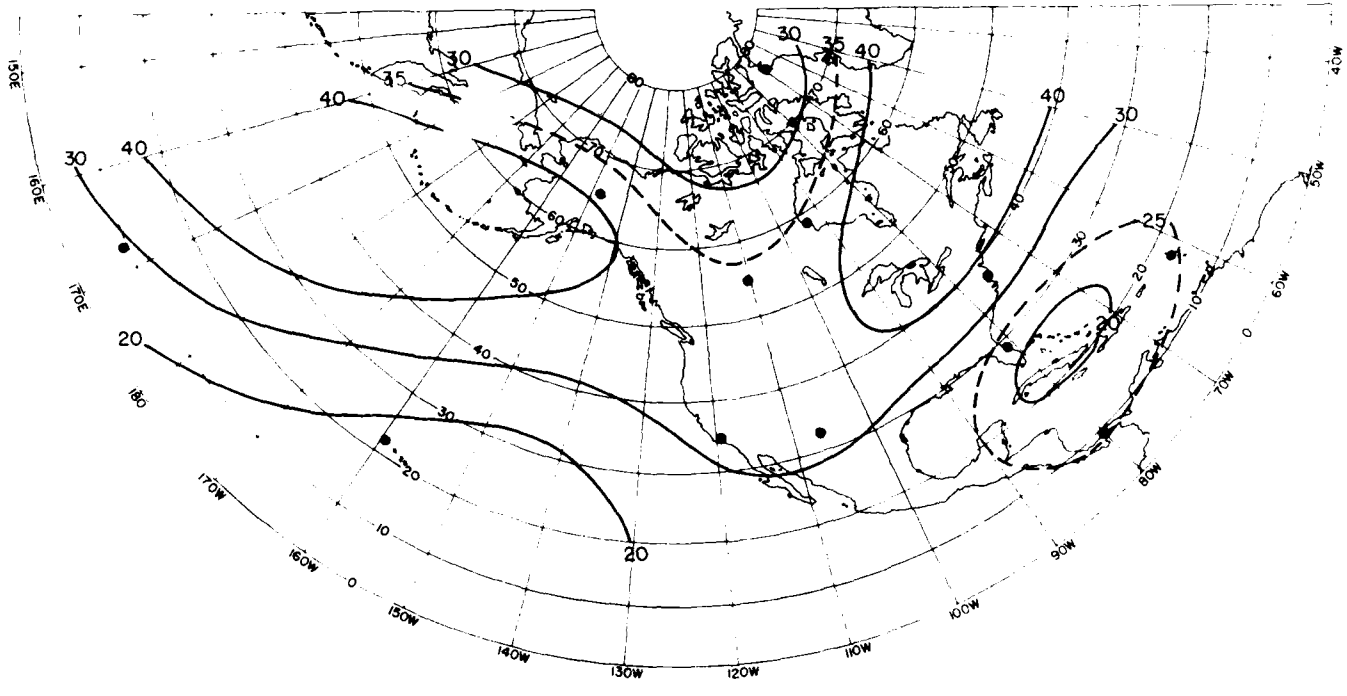

Figure A22. Scalar Speed (m/sec) at 35 km in October, 10-percent Extreme

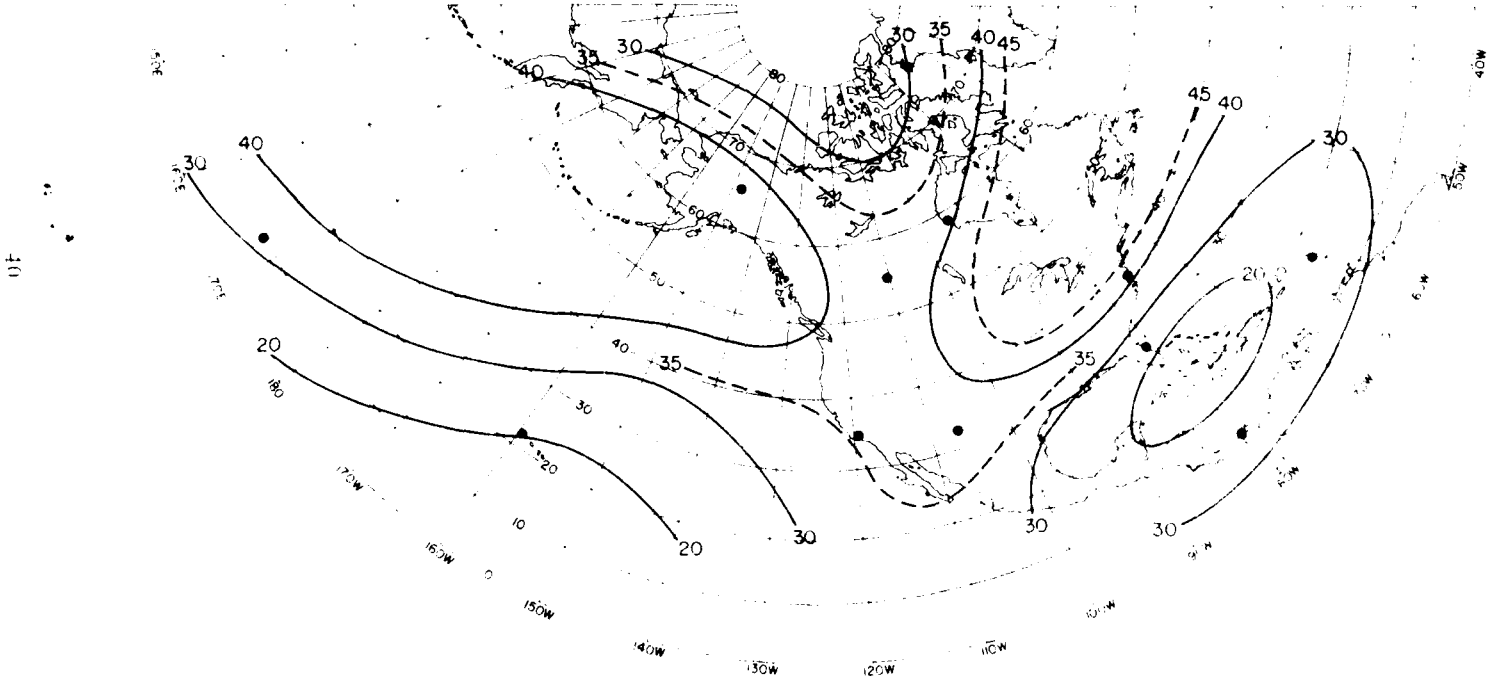

Figure A23. Scalar Speed (m/sec) at 35 km in October, 5-percent Extreme

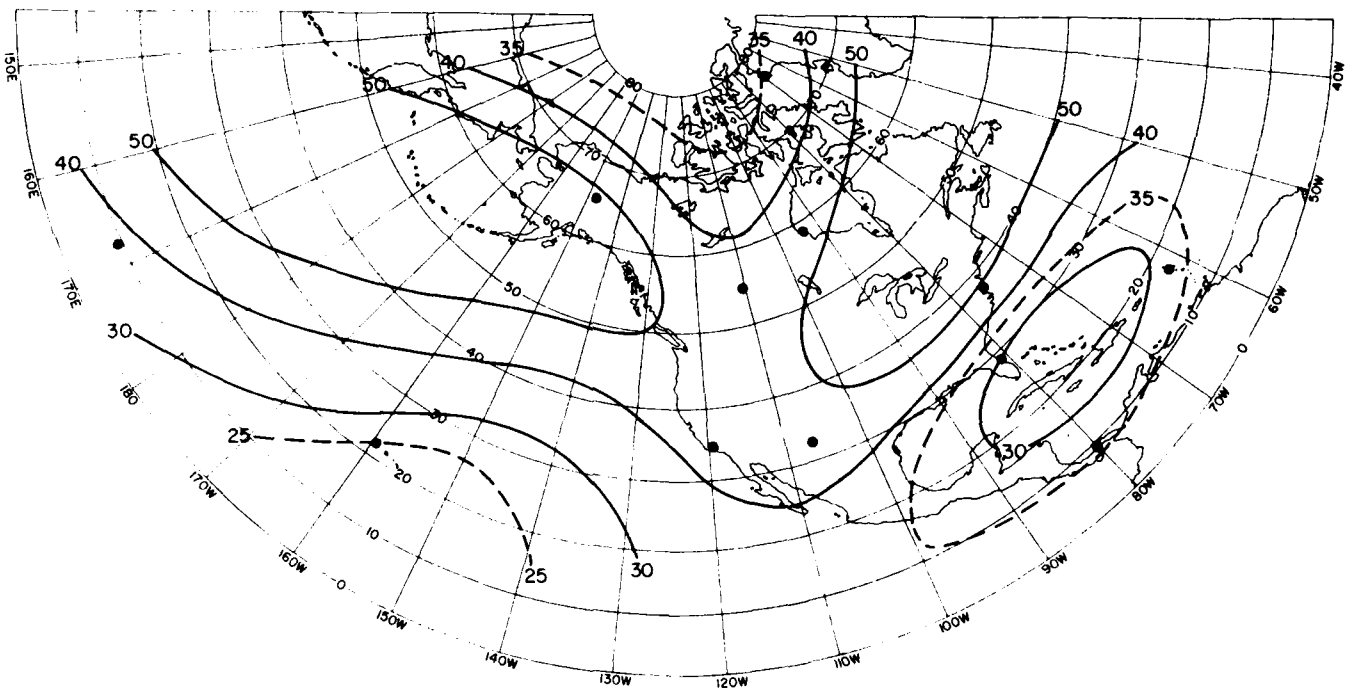

Figure A24. Scalar Speed (m/sec) at 35 km in October, 1-percent Extreme

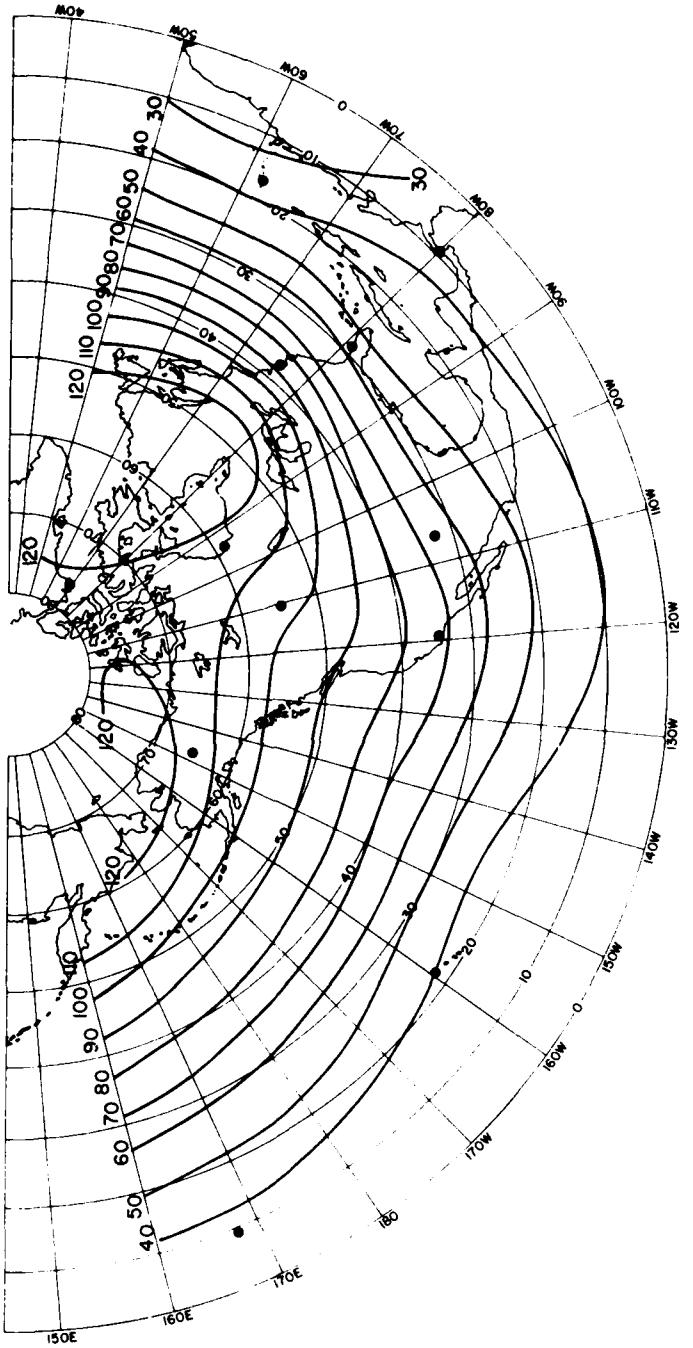

Figure A25. Scalar Speed (m/sec) at 40 km in January, 10-percent Extreme

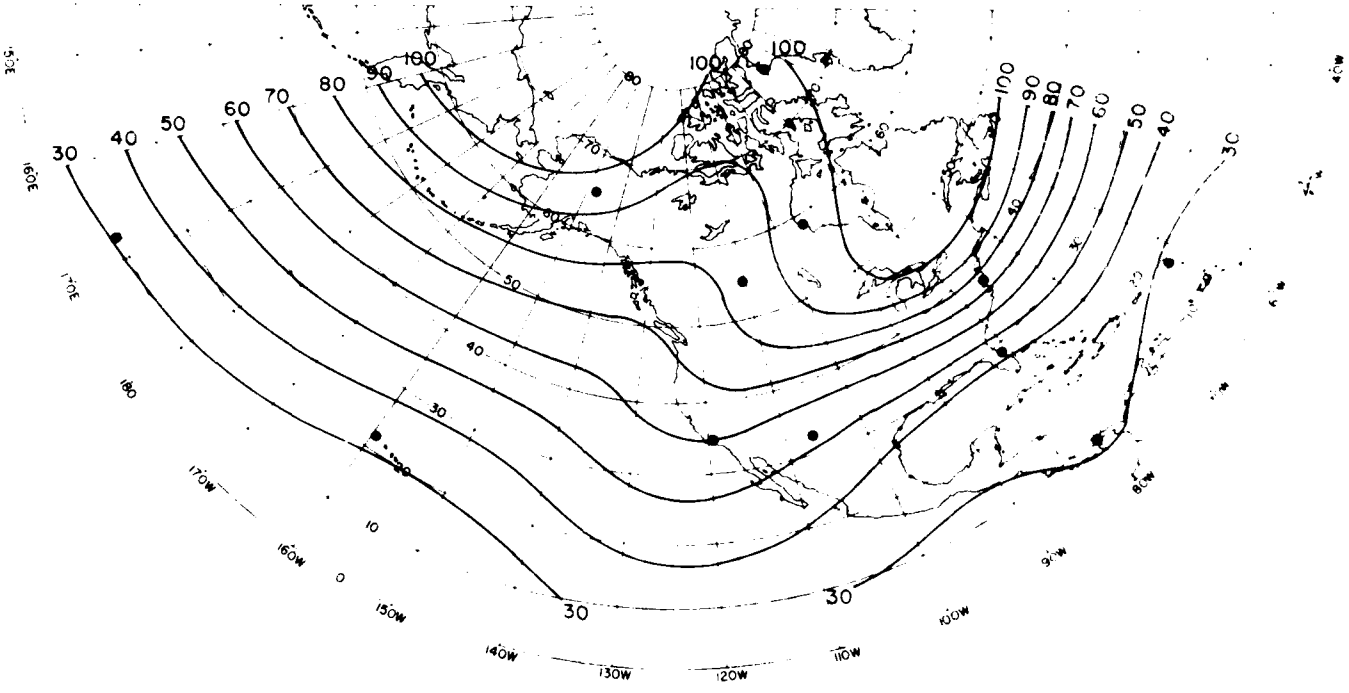

Figure A26. Scalar Speed (m/sec) at 40 km in January, 5-percent Extreme

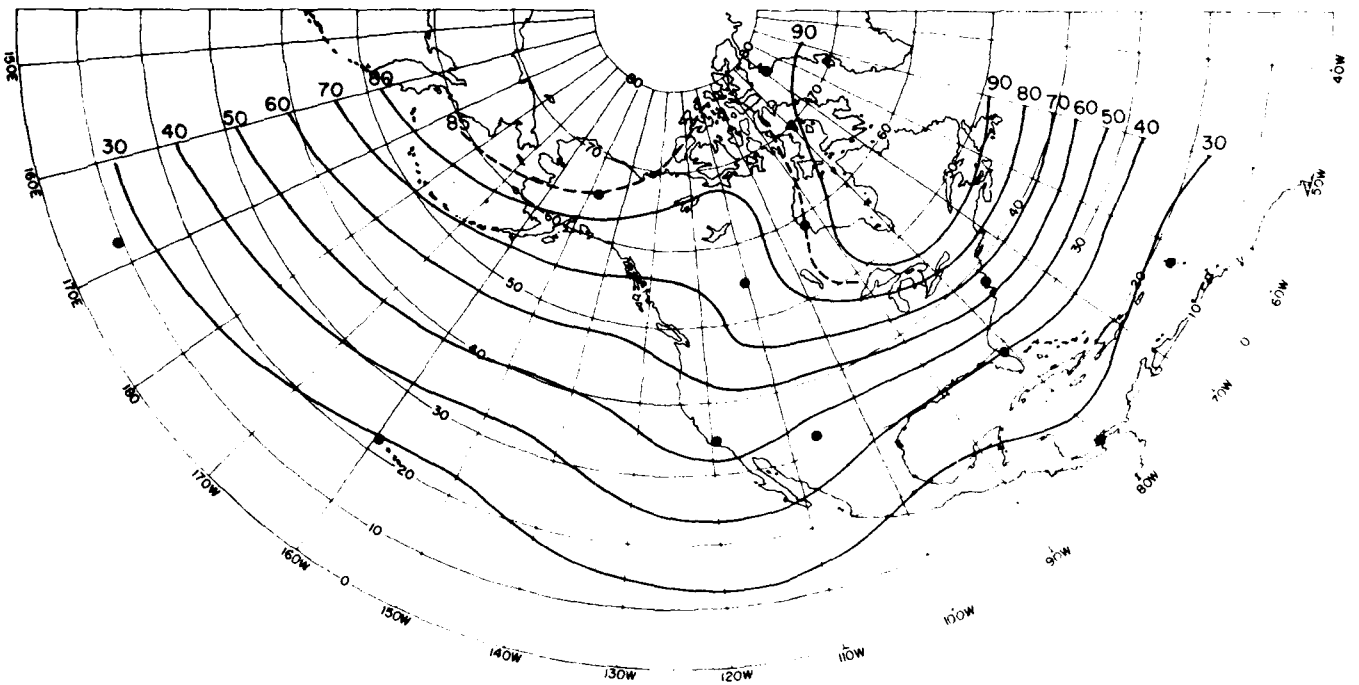

Figure A27. Scalar Speed (m/sec) at 40 km in January, 1-percent Extreme

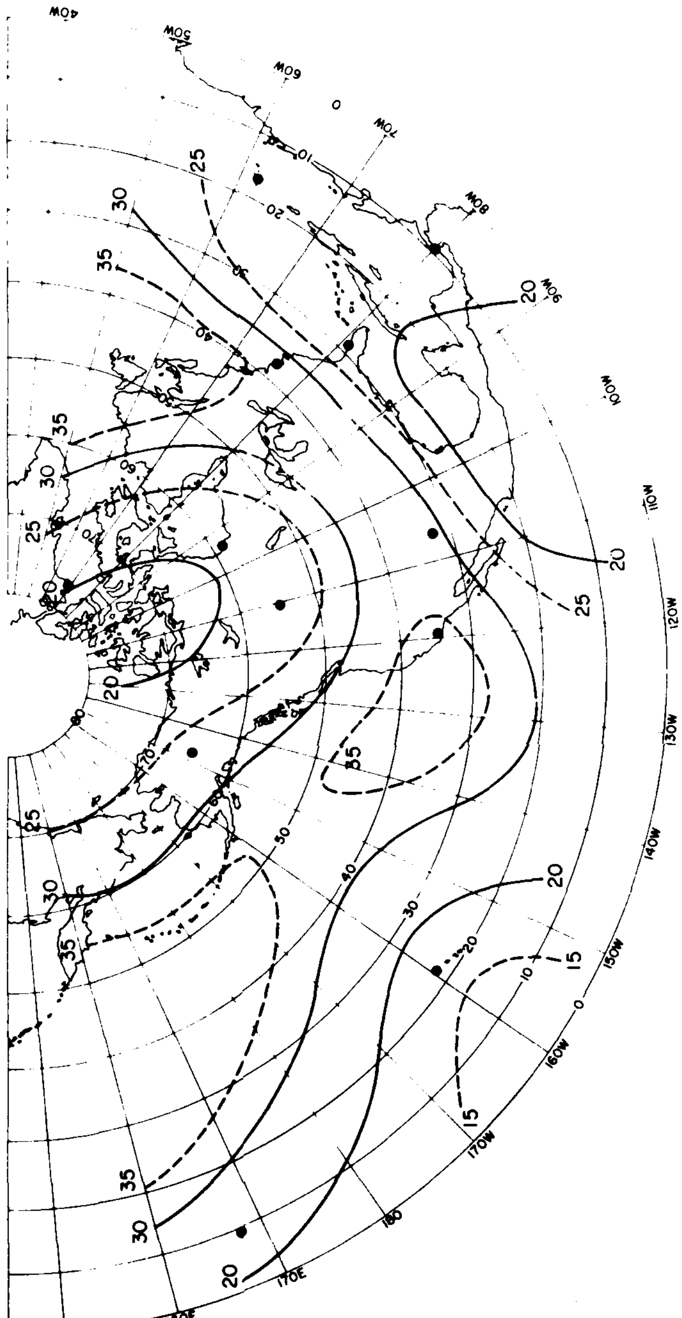

Figure A28. Scalar Speed (m/sec) at 40 km in April, 10-percent Extreme

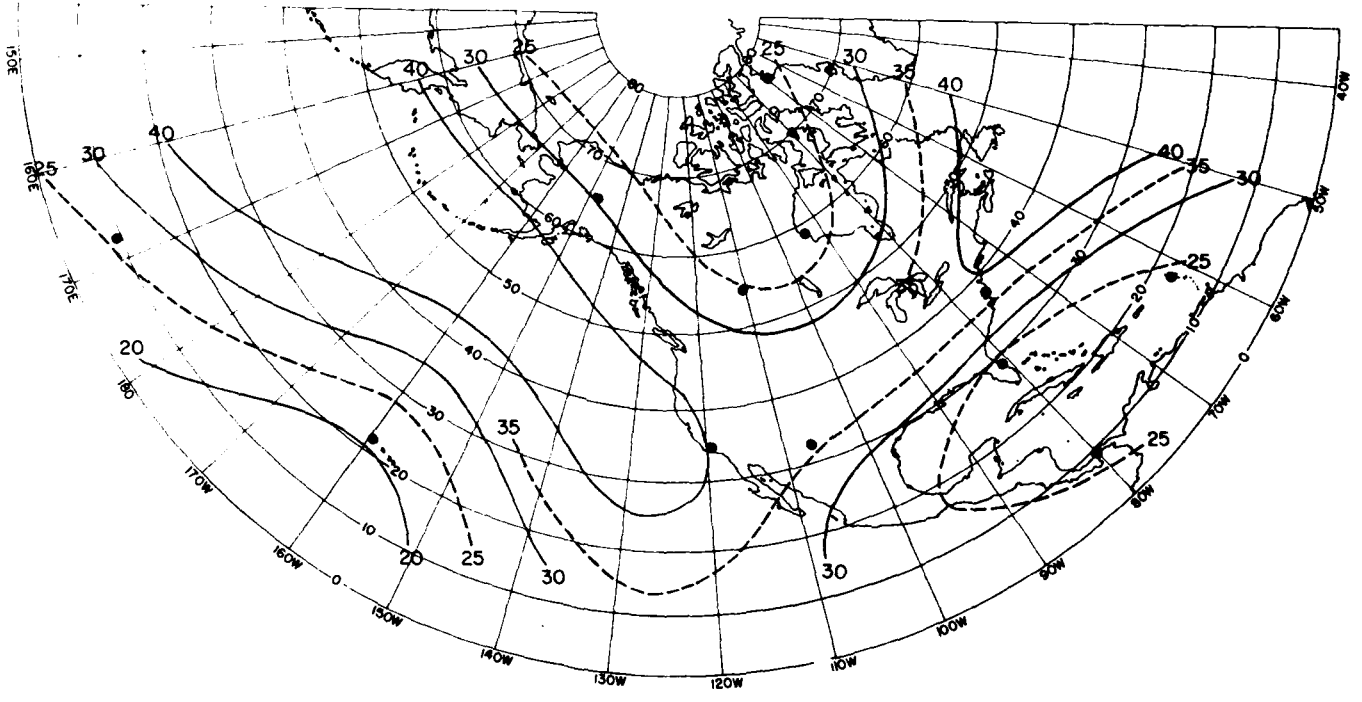

Figure A29. Scalar Speed (m/sec) at 40 km in April, 5-percent Extreme

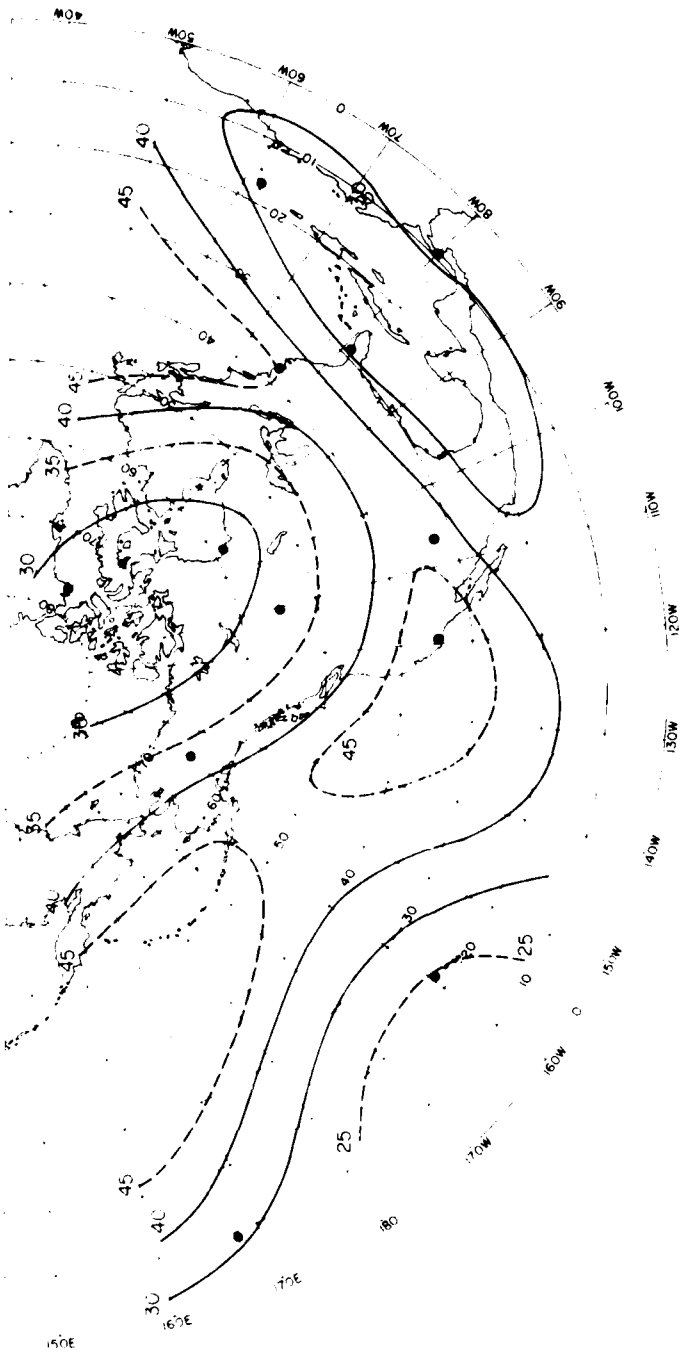

Figure A30. Scalar Speed (m/sec) at 40 km in April, 1-percent Extreme

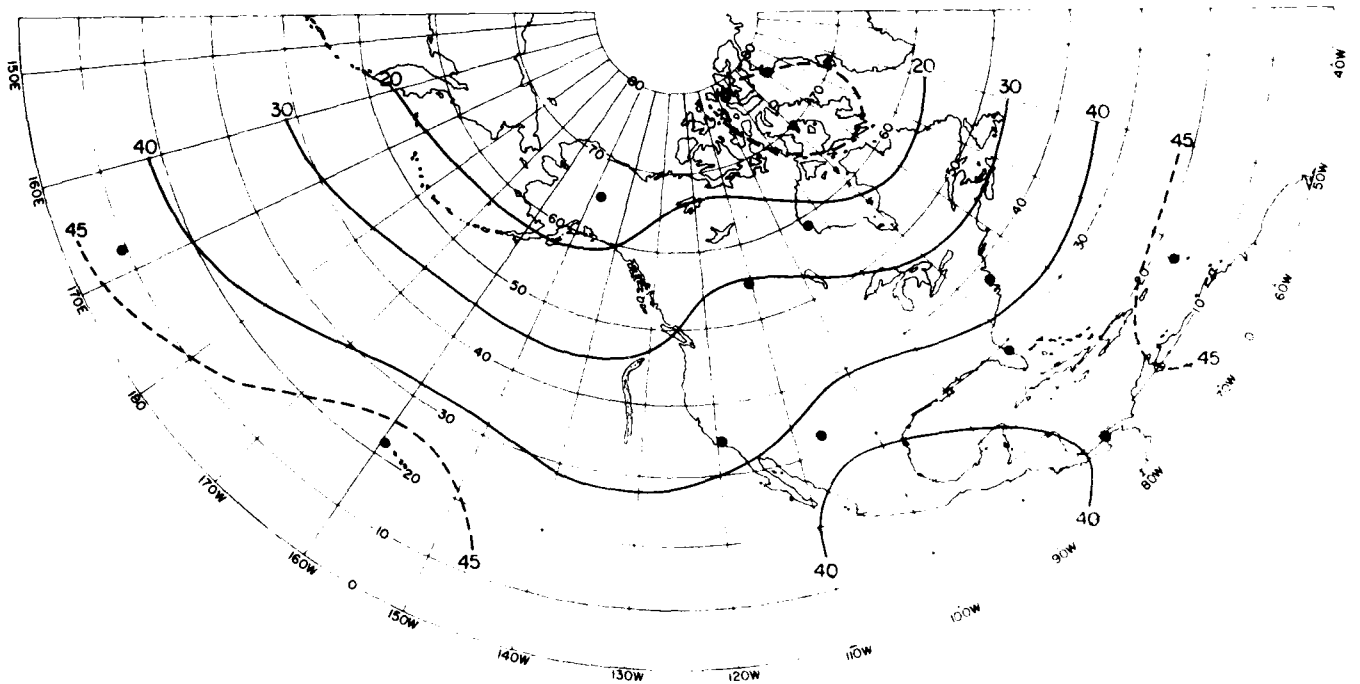

Figure A31. Scalar Speed (m/sec) at 40 km in July, 10-percent Extreme

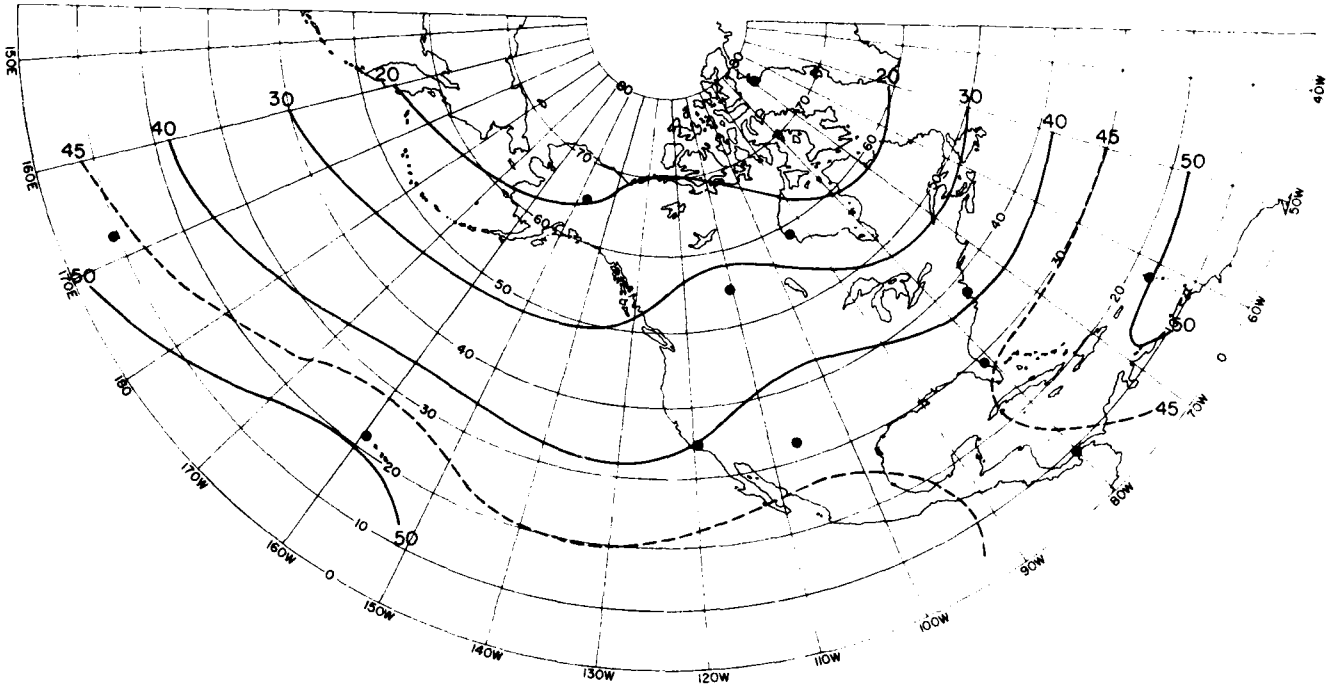

Figure A32. Scalar Speed (m/sec) at 40 km in July, 5-percent Extreme

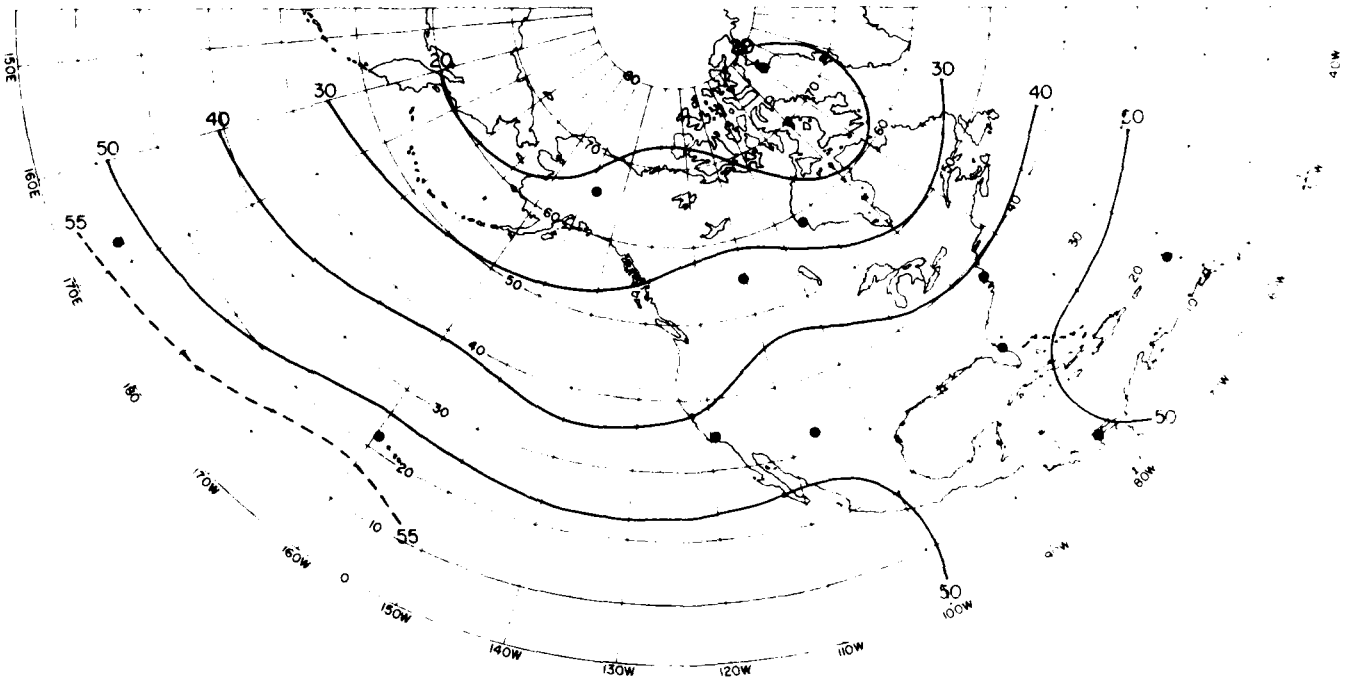

Figure A33. Scalar Speed (m/sec) at 40 km in July, 1-percent Extreme

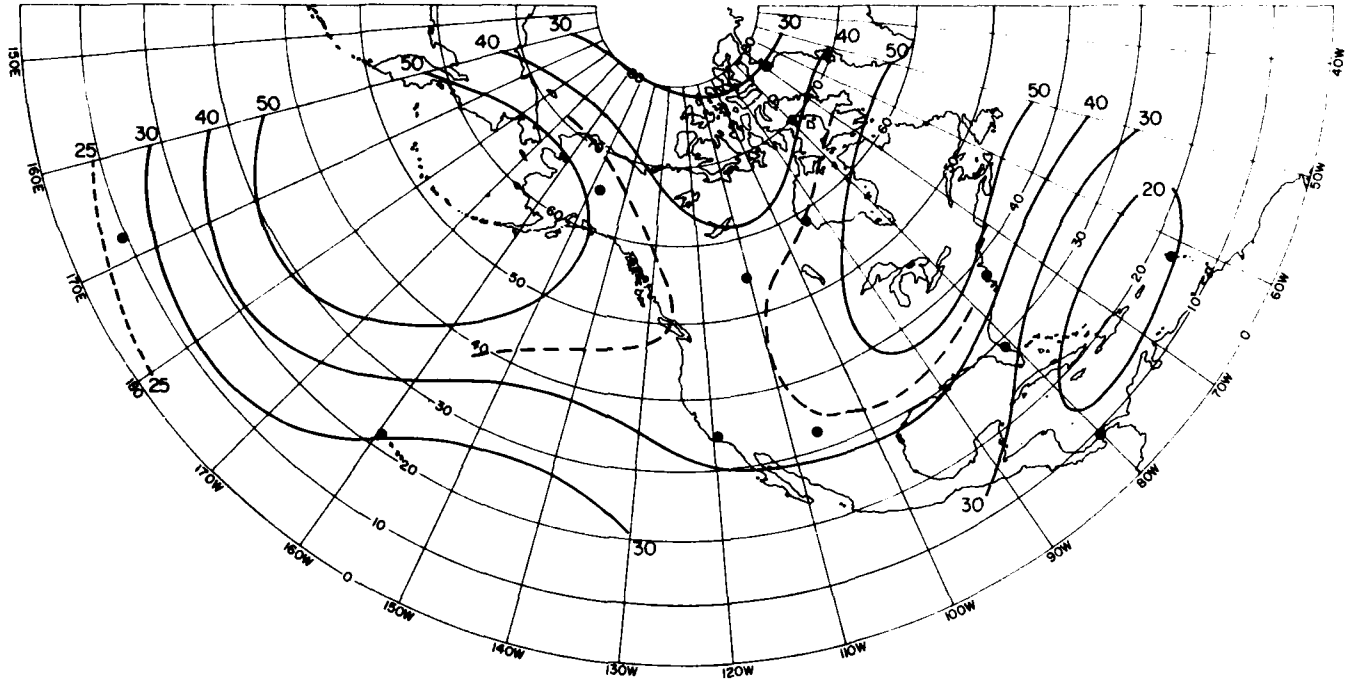

Figure A34. Scalar Speed (m/sec) at 40 km in October, 10-percent Extreme

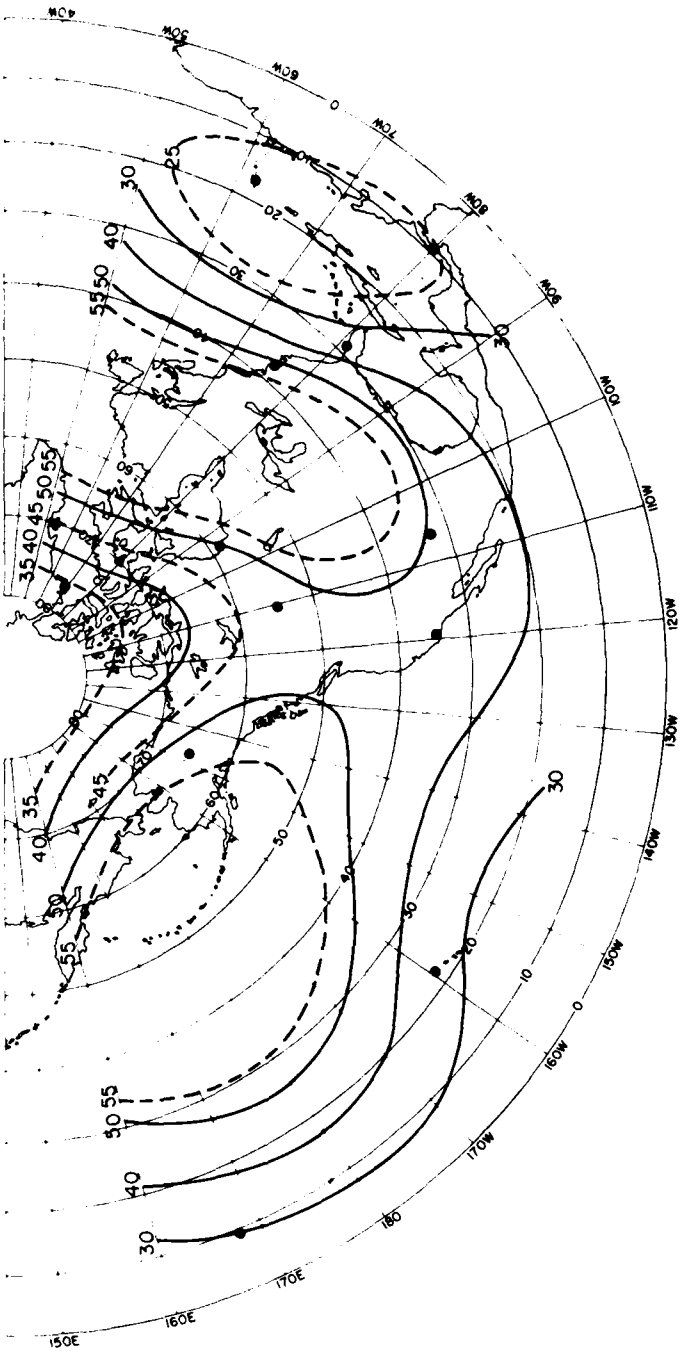

Figure A35. Scalar Speed (m/sec) at 40 km in October, 5-percent Extreme

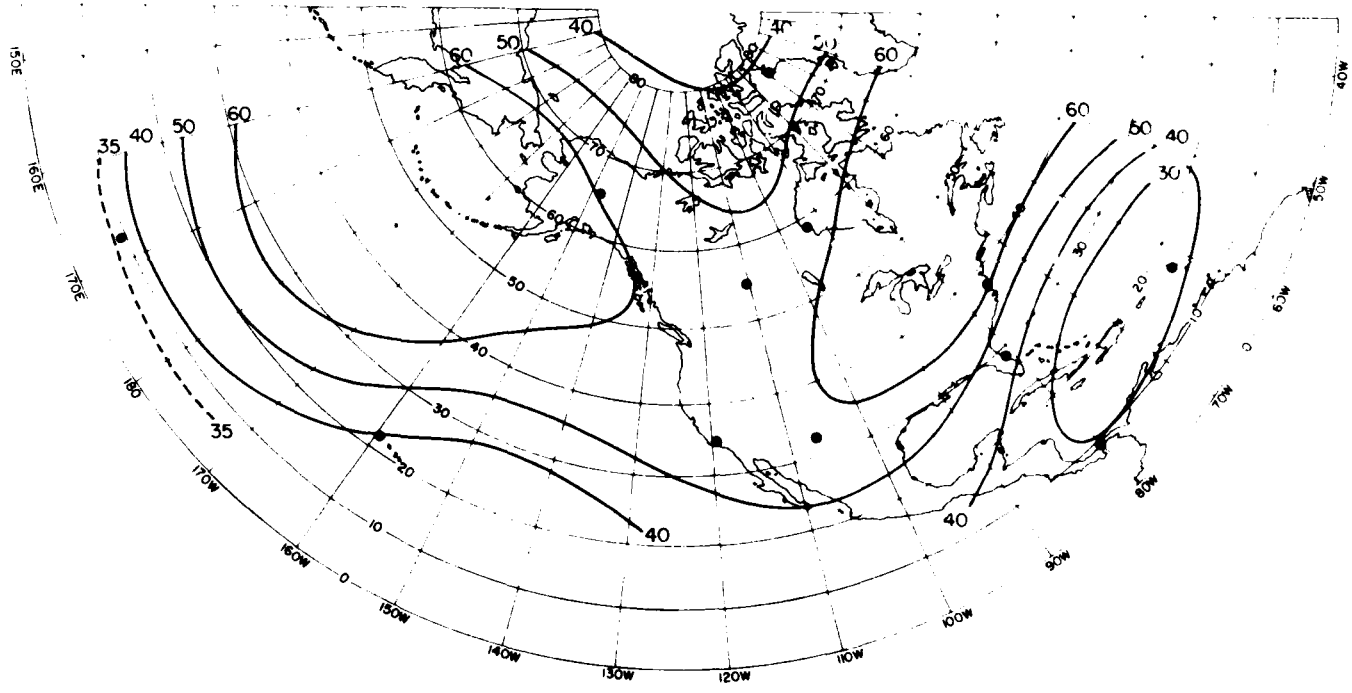

Figure A36. Scalar Speed (m/sec) at 40 km in October, 1-percent Extreme

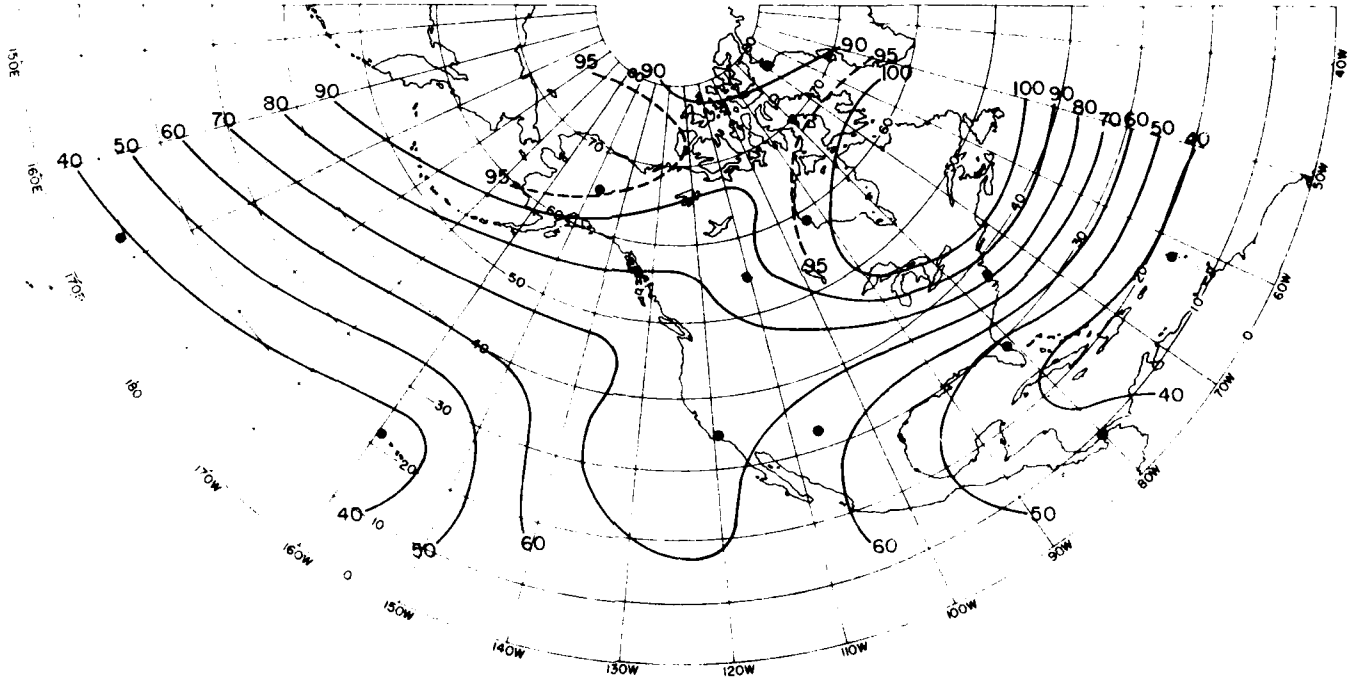

Figure A37. Scalar Speed (m/sec) at 45 km in January, 10-percent Extreme

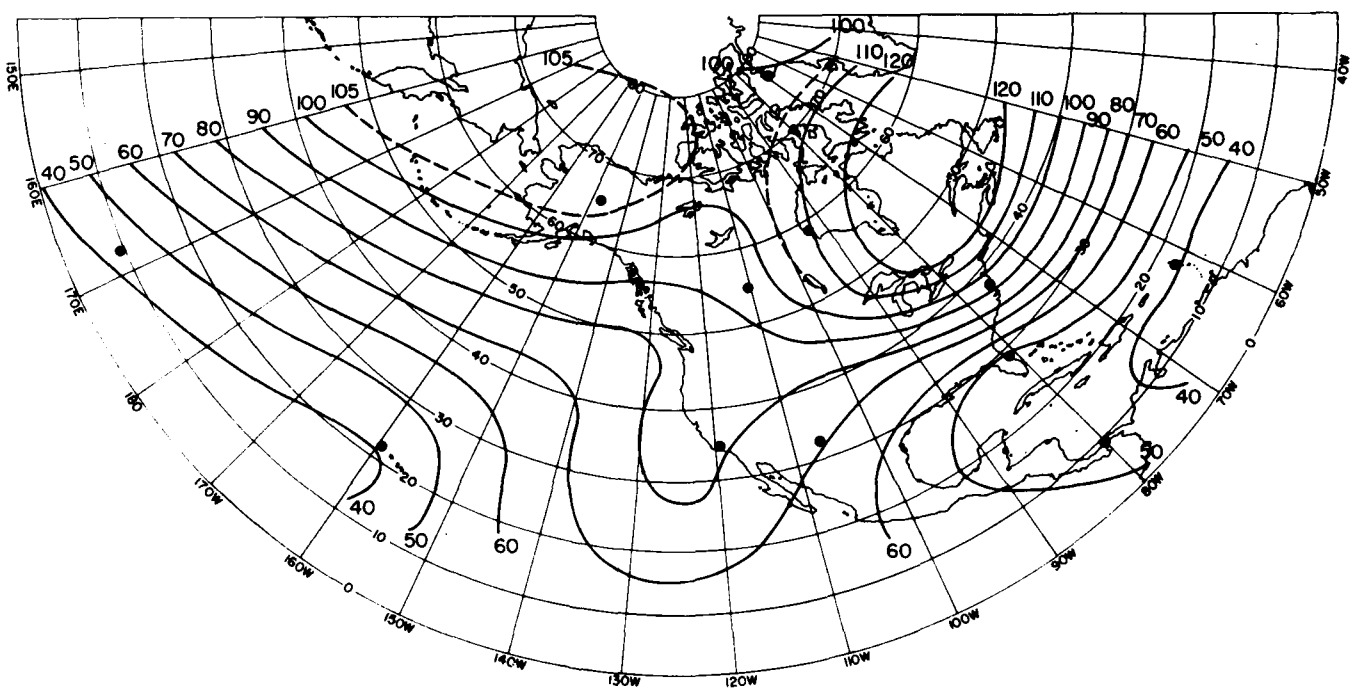

Figure A38. Scalar Speed (m/sec) at 45 km in January, 5-percent Extreme

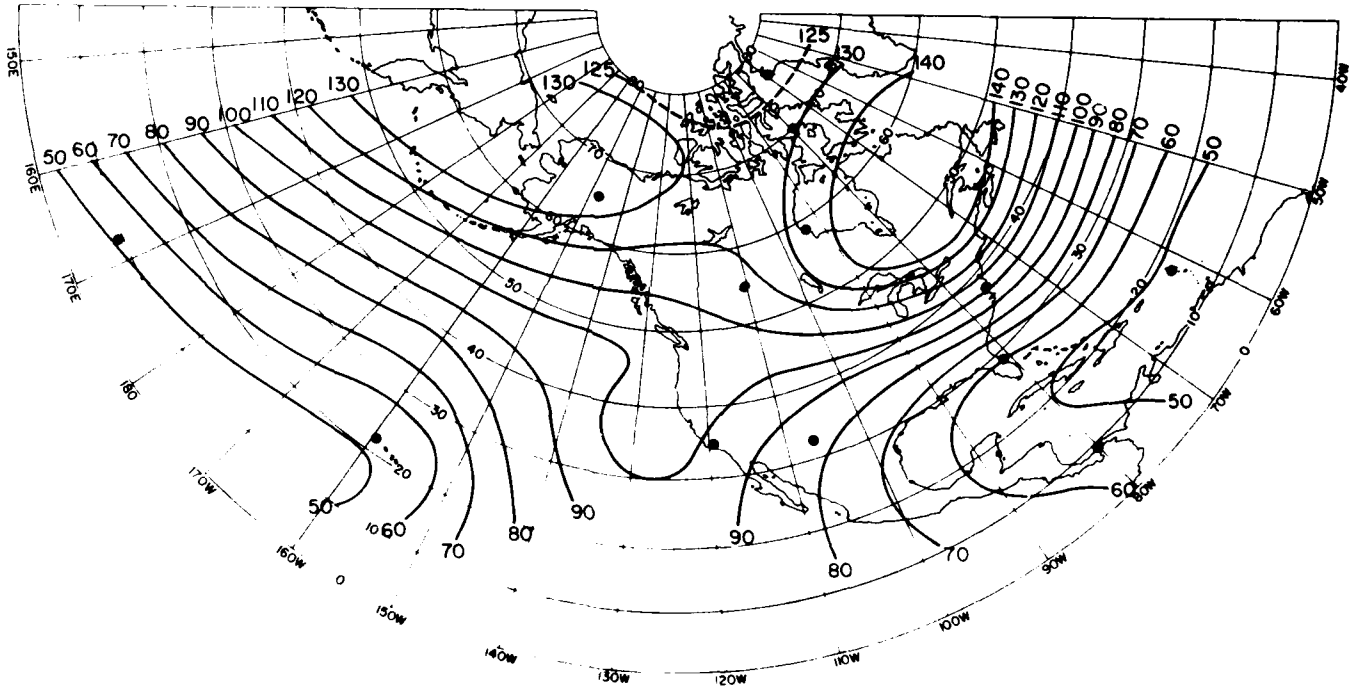

Figure A39. Scalar Speed (m/sec) at 45 km in January, 1-percent Extreme

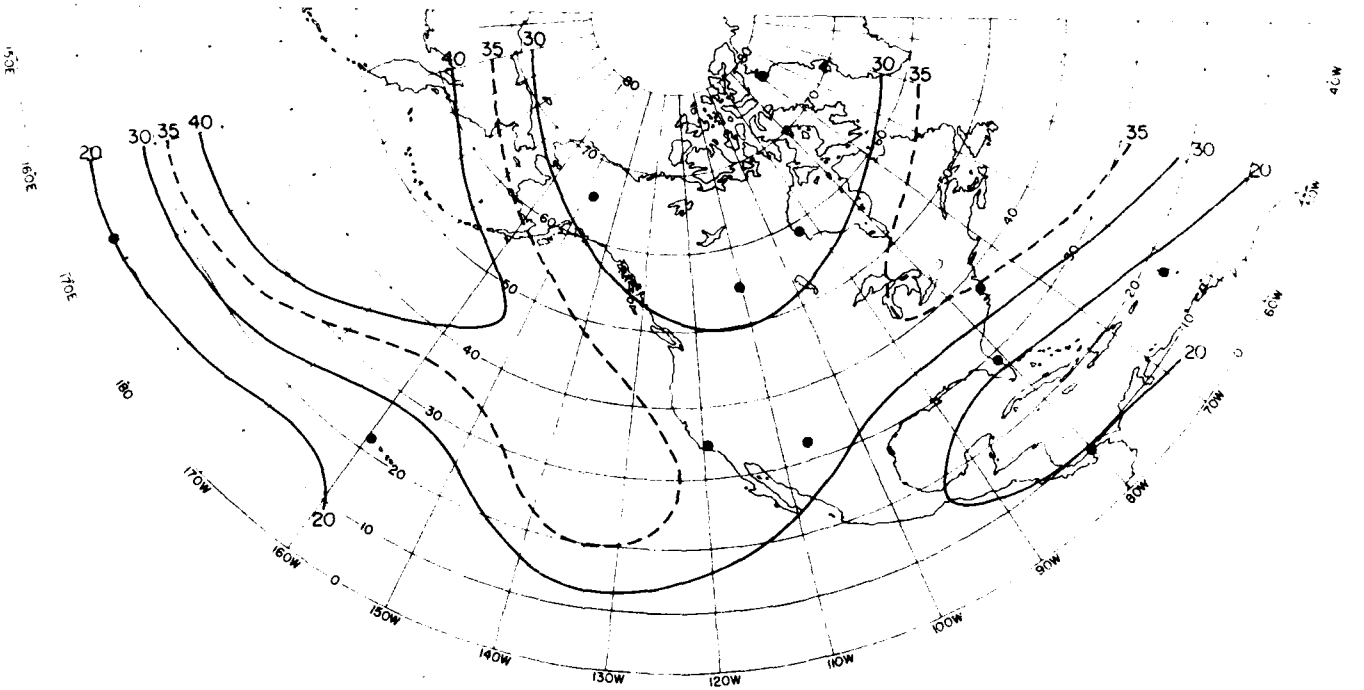

Figure A40. Scalar Speed (m/sec) at 45 km in April, 10-percent Extreme

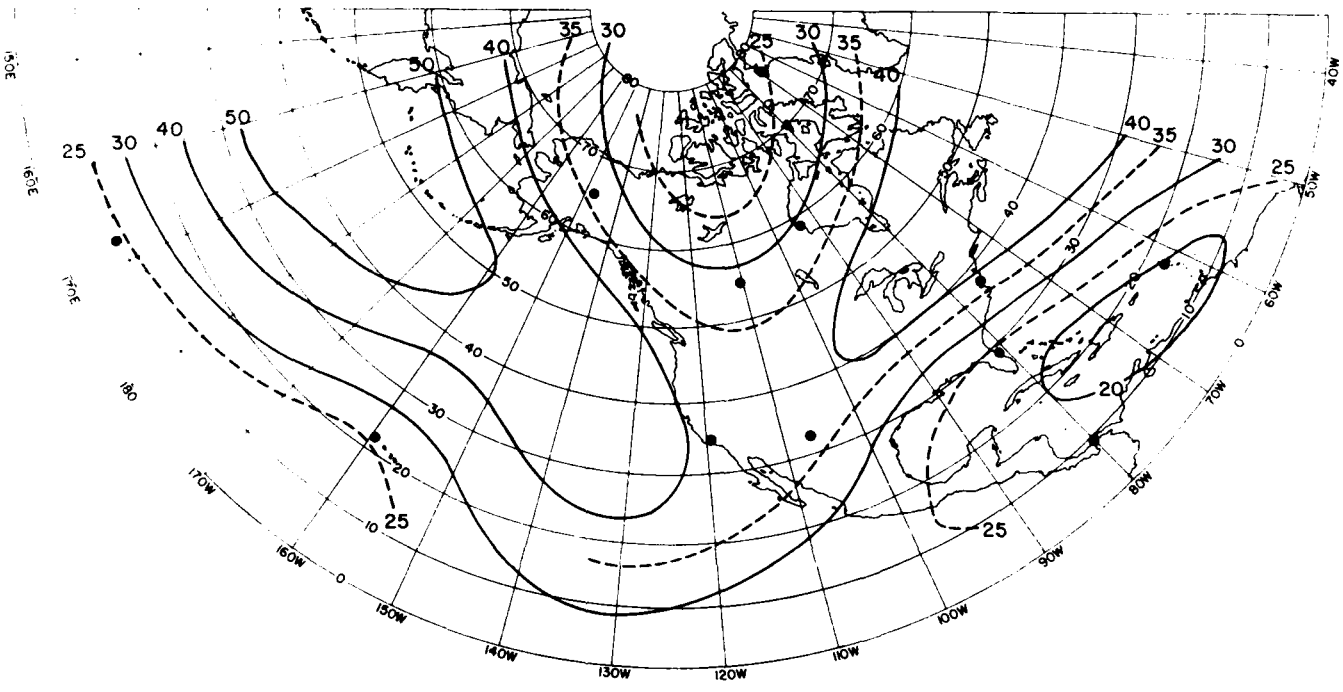

Figure A41. Scalar Speed (m/sec) at 45 km in April, 5-percent Extreme

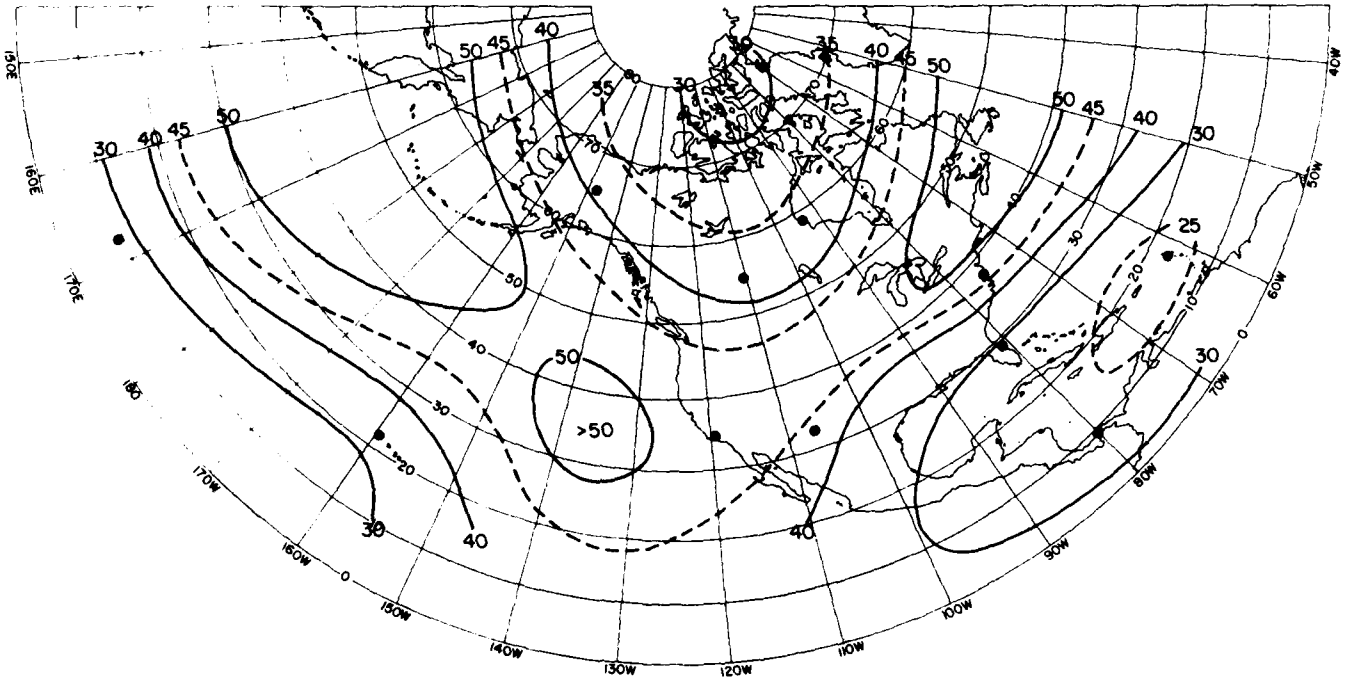

Figure A42. Scalar Speed (m/sec) at 45 km in April, 1-percent Extreme

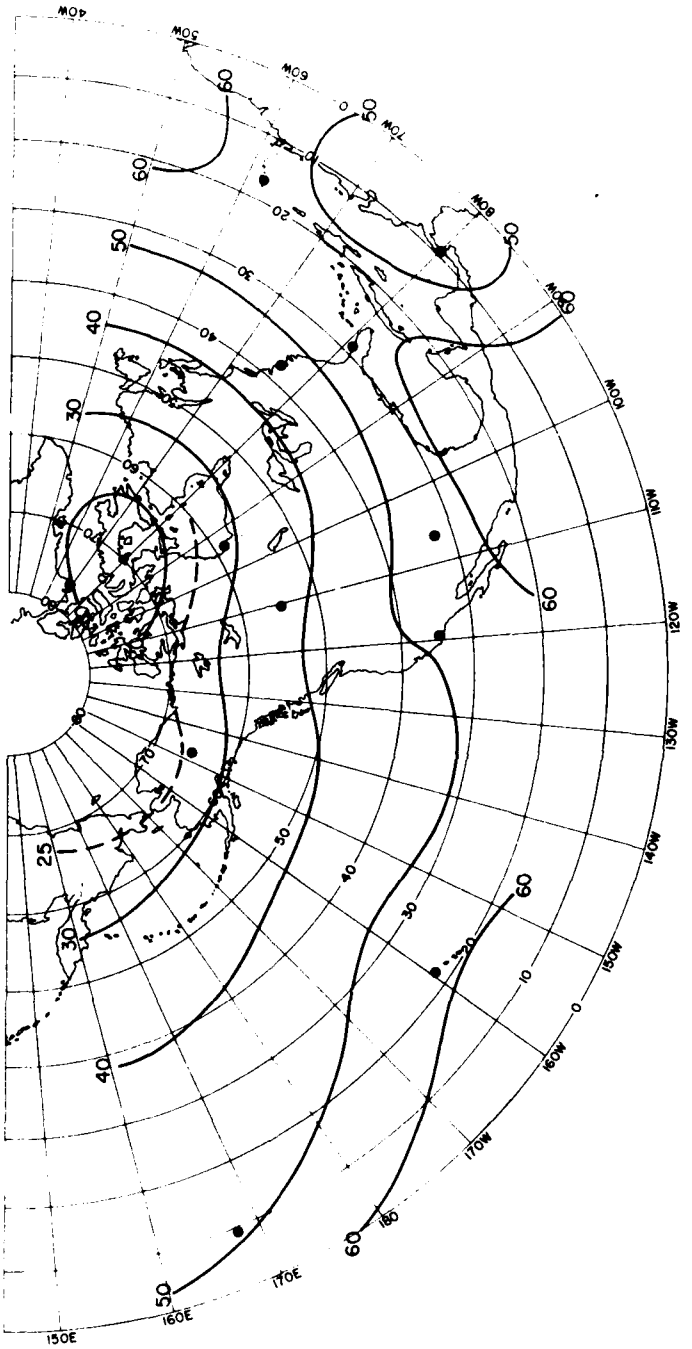

Figure A43. Scalar Speed (m/sec) at 45 km in July, 10-percent Extreme

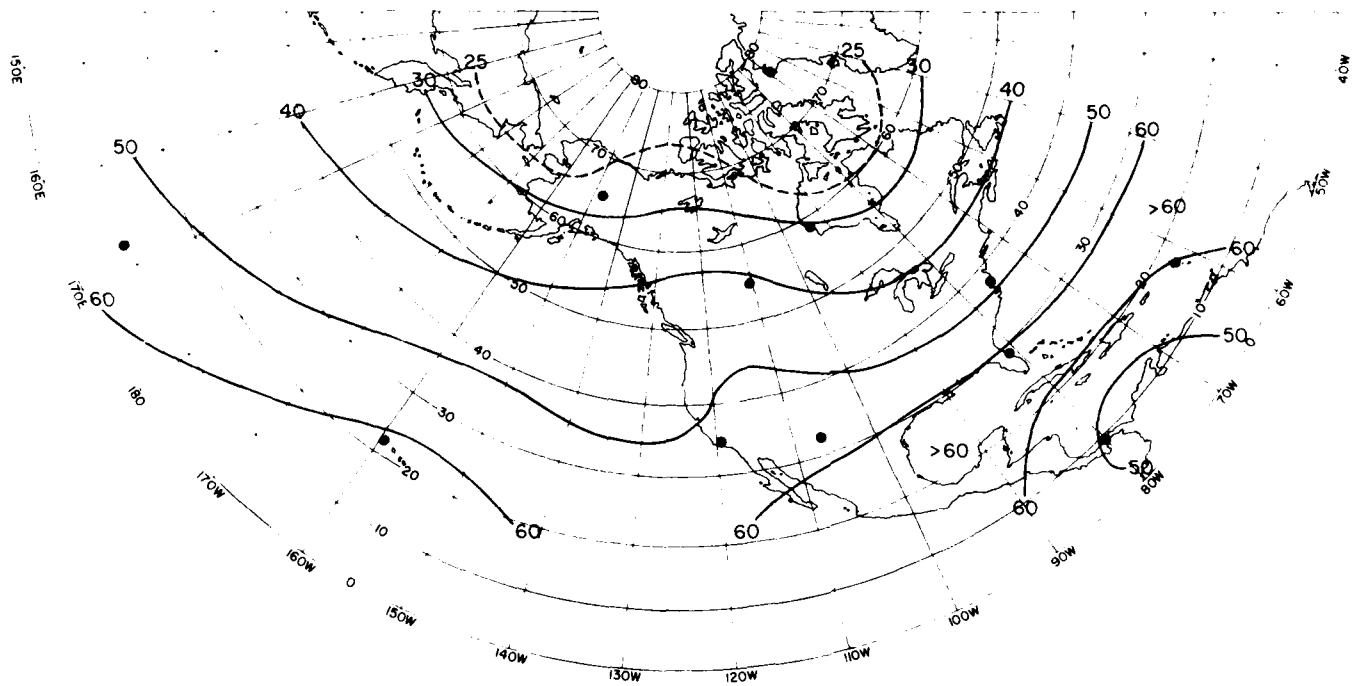

Figure A44. Scalar Speed (m/sec) at 45 km in July, 5-percent Extreme

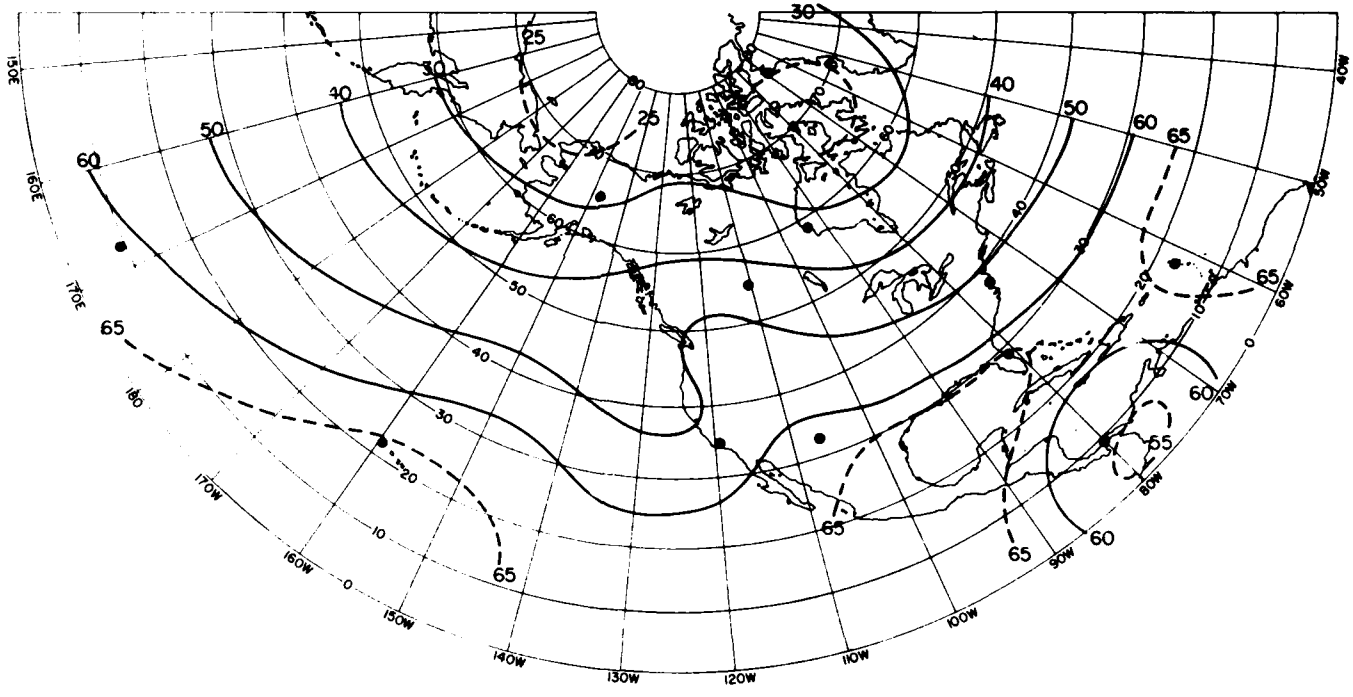

Figure A45. Scalar Speed (m/sec) at 45 km in July, 1-percent Extreme

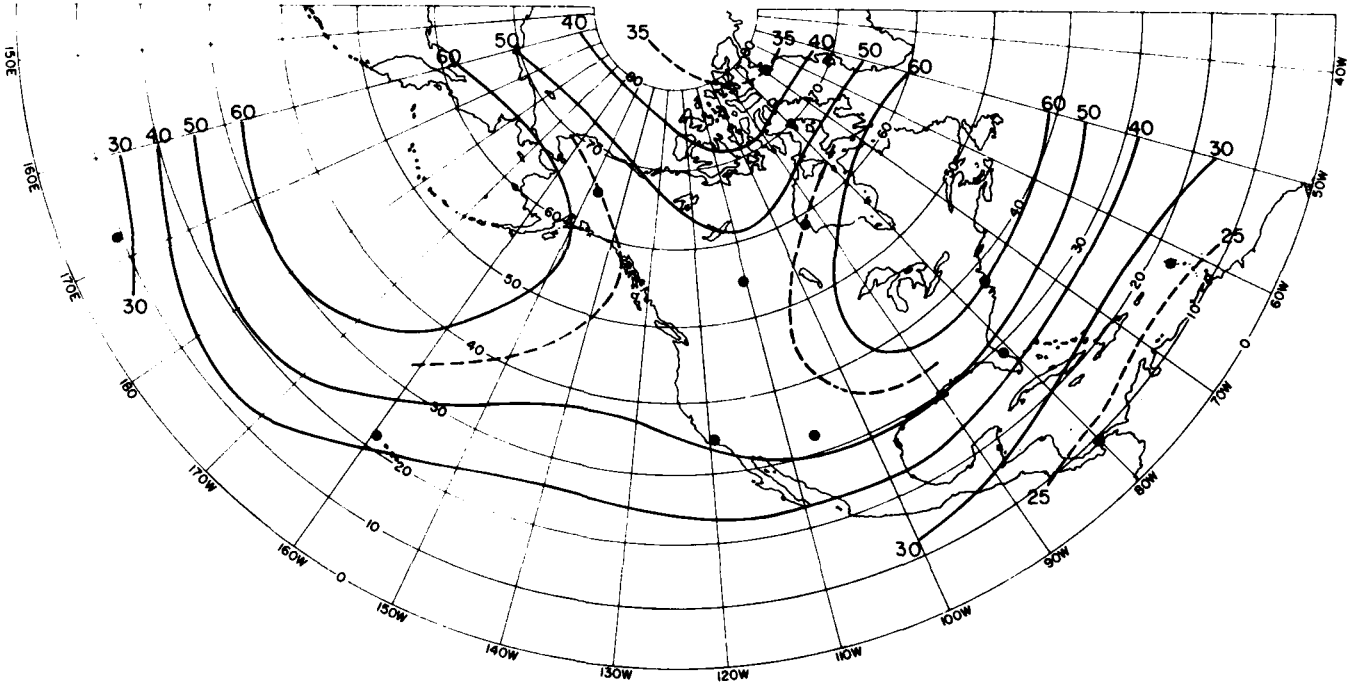

Figure A46. Scalar Speed (m/sec) at 45 km in October, 10-percent Extreme

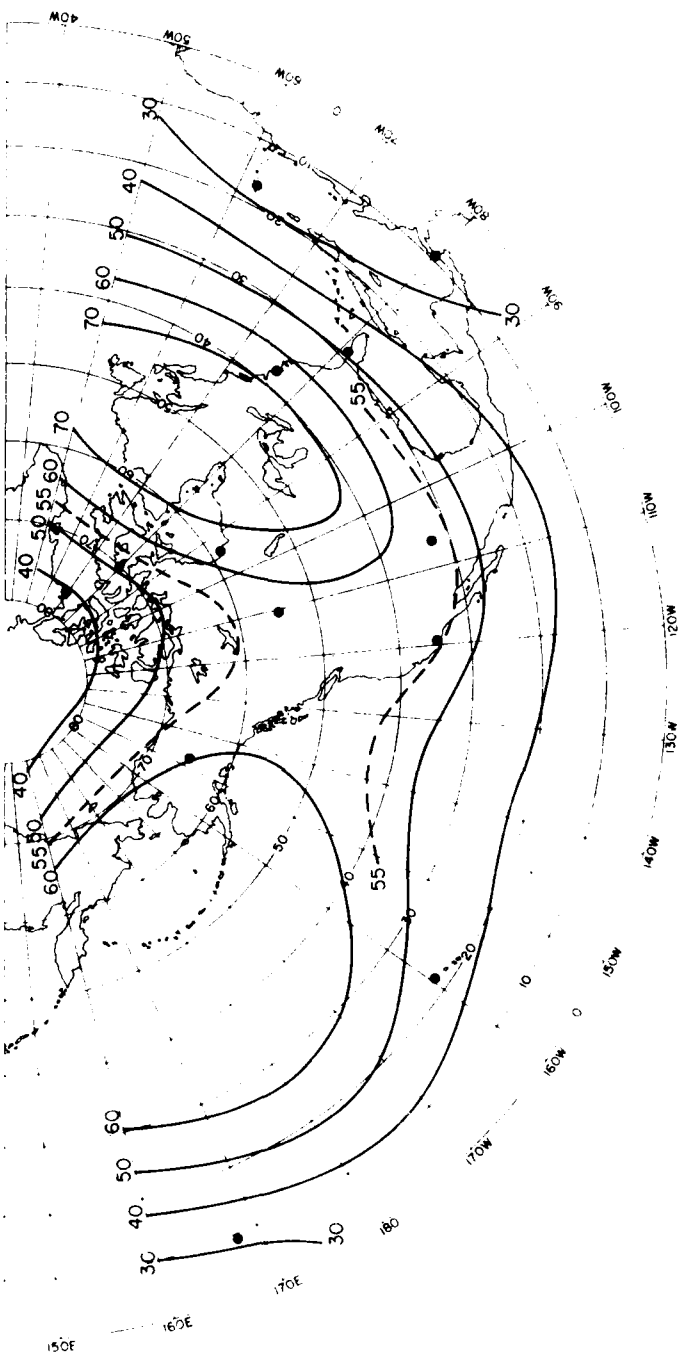

Figure A47. Scalar Speed (m/sec) at 45 km in October, 5-percent Extreme

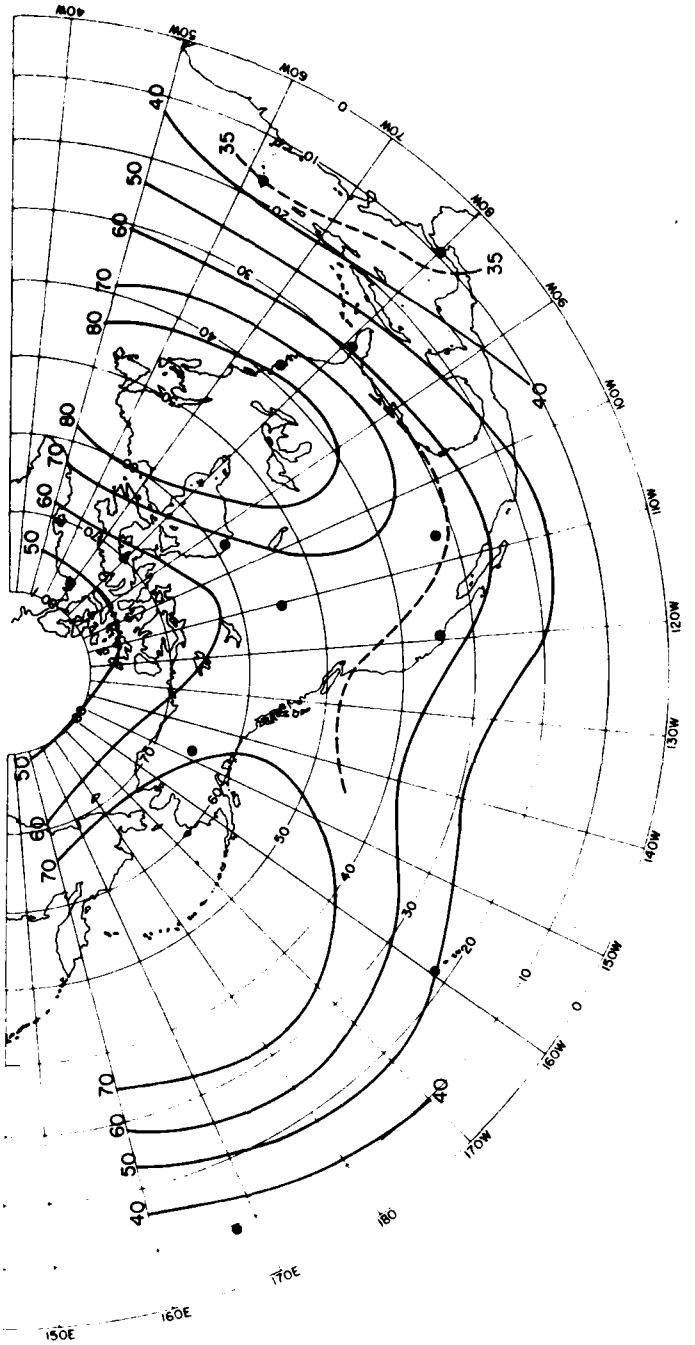

Figure A48. Scalar Speed (m/sec) at 45 km in October, 1-percent Extreme

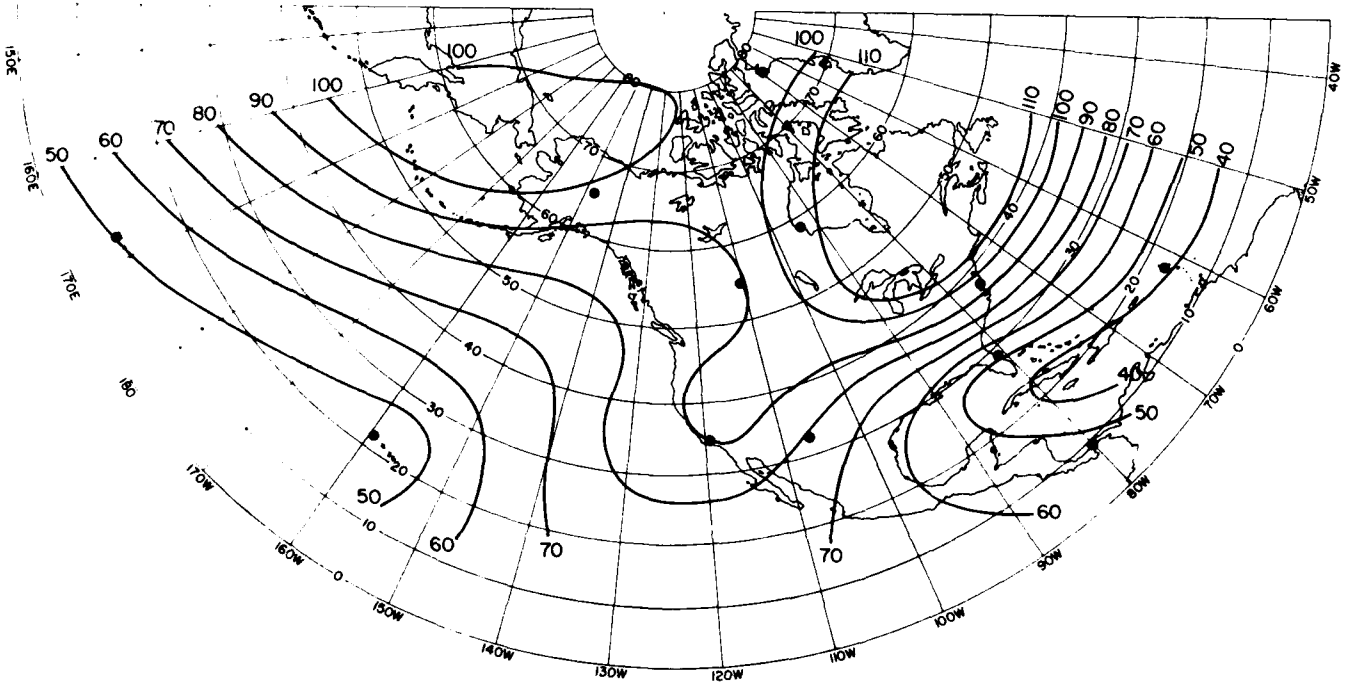

Figure A49. Scalar Speed (m/sec) at 50 km in January, 10-percent Extreme

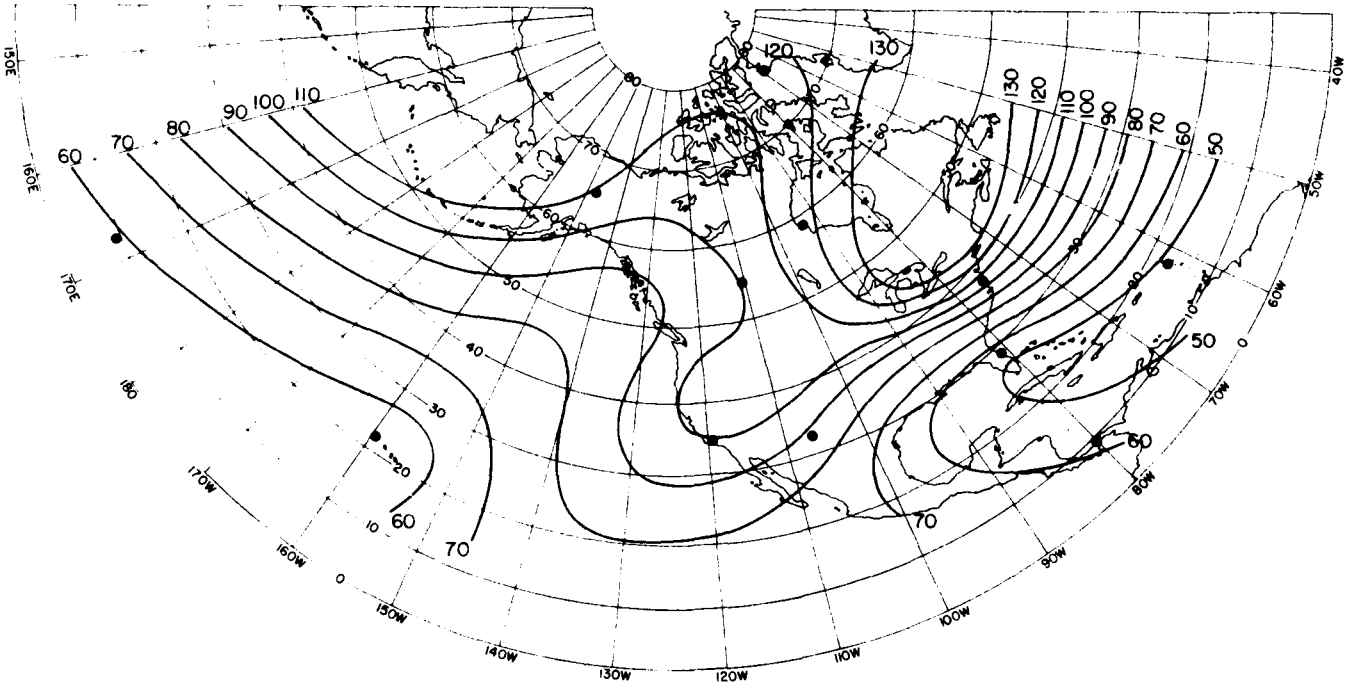

Figure A50. Scalar Speed (m/sec) at 50 km in January, 5-percent Extreme

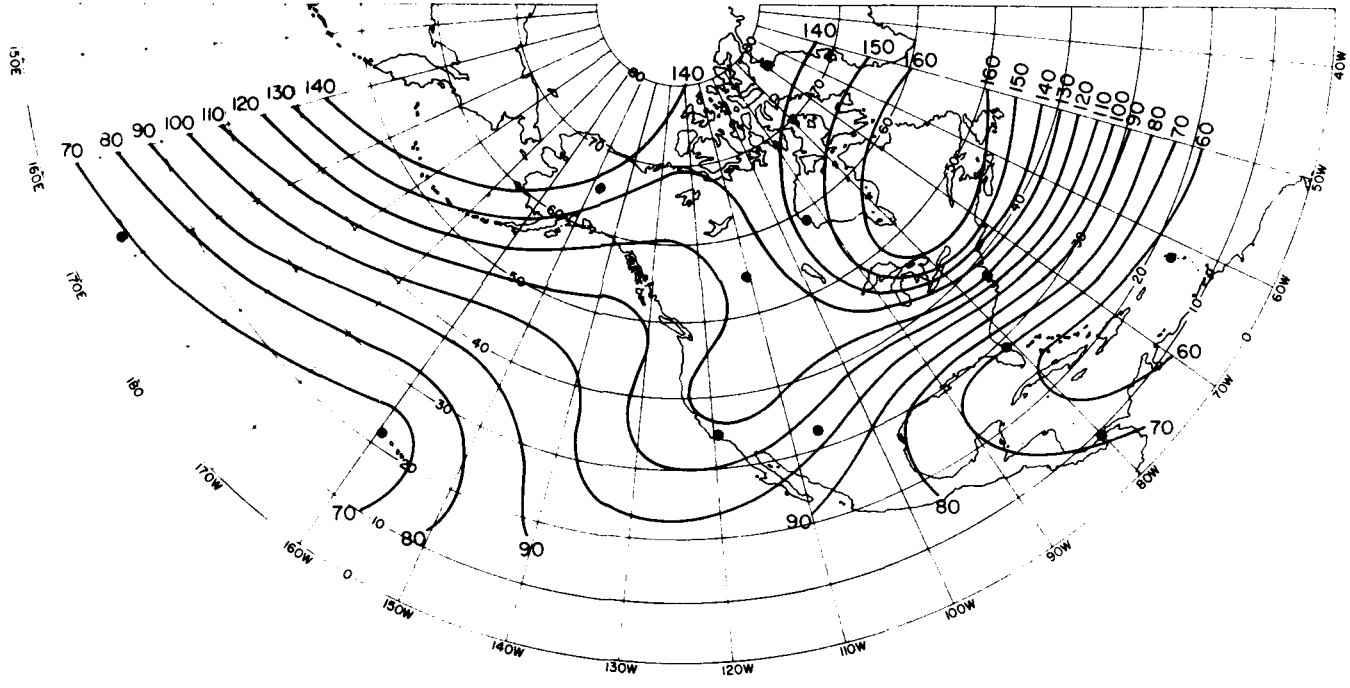

Figure A51. Scalar Speed (m/sec) at 50 km in January, 1-percent Extreme

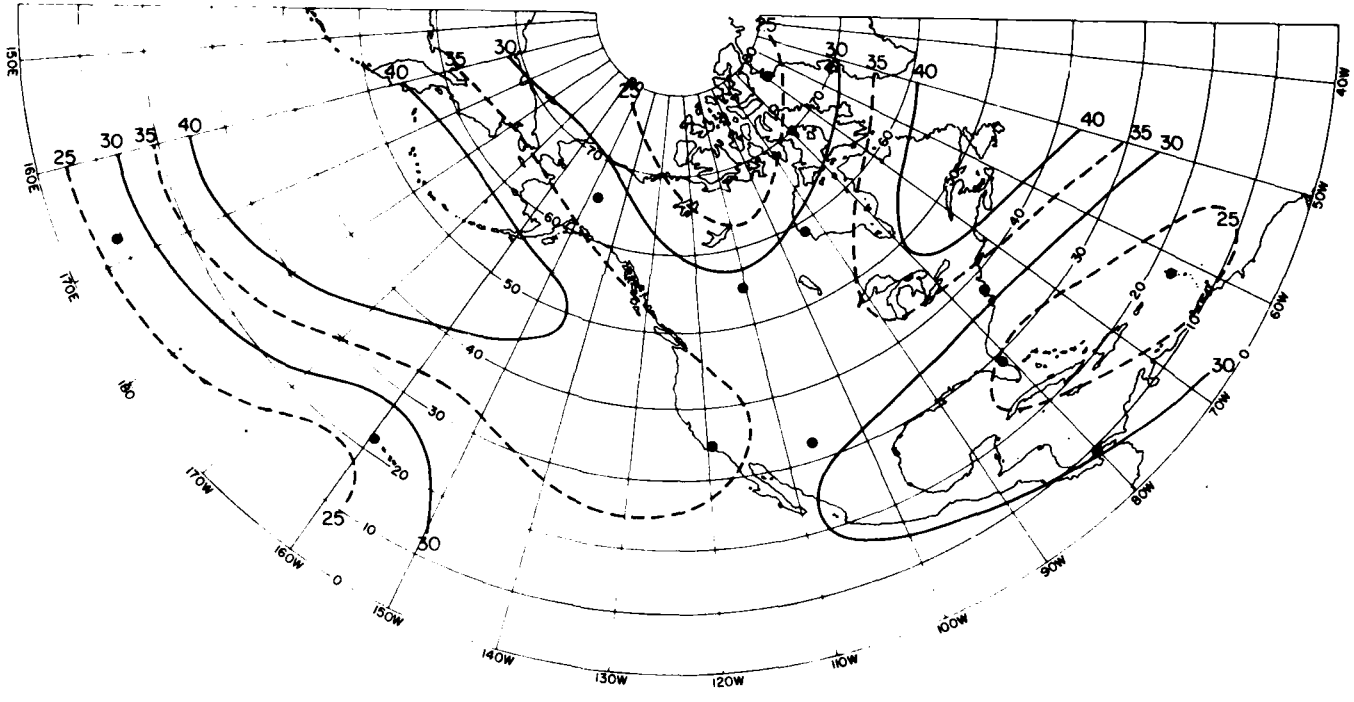

Figure A52. Scalar Speed (m/sec) at 50 km in April, 10-percent Extreme

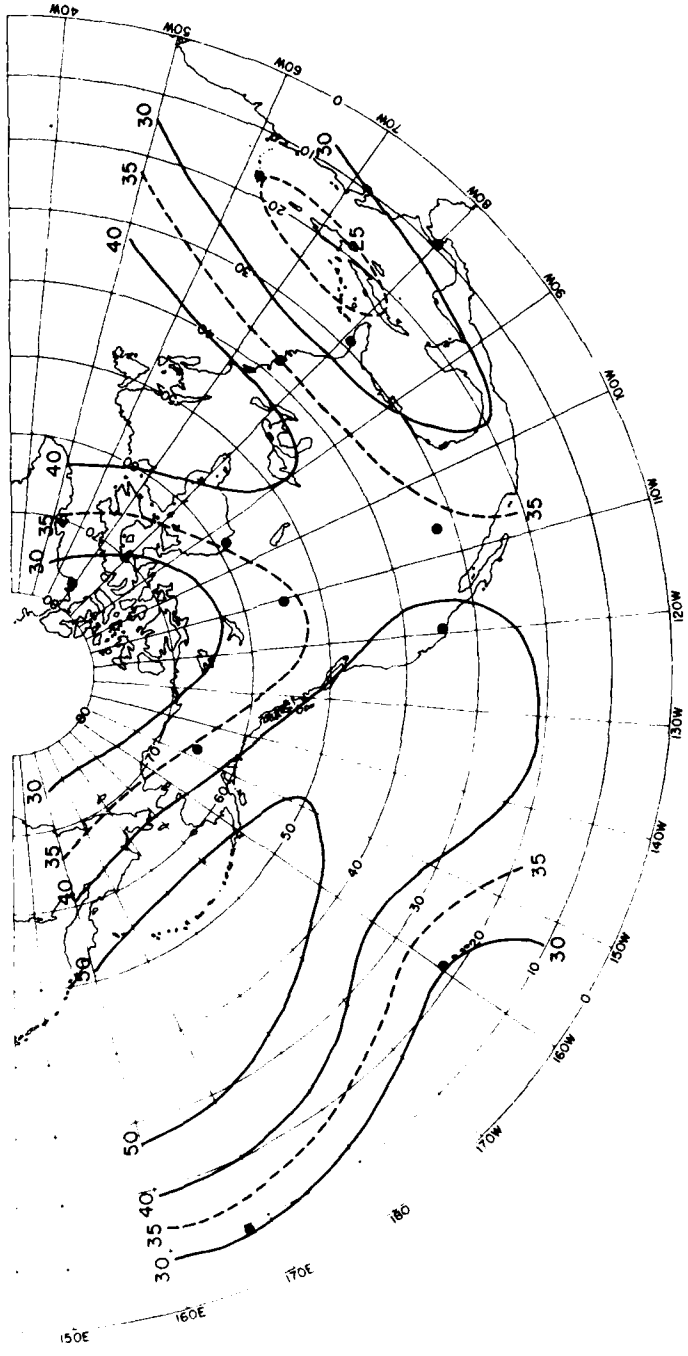

Figure A53. Scalar Speed (m/sec) at 50 km in April, 5-percent Extreme

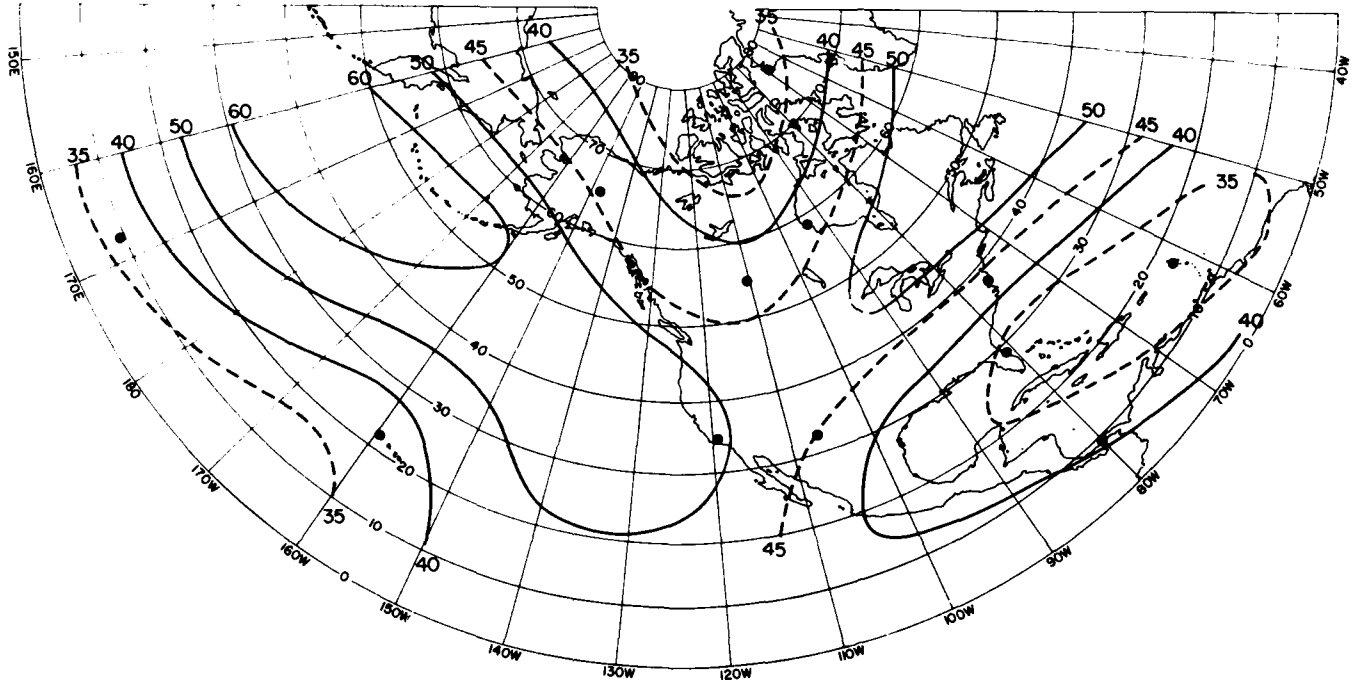

Figure A54. Scalar Speed (m/sec) at 50 km in April, 1-percent Extreme

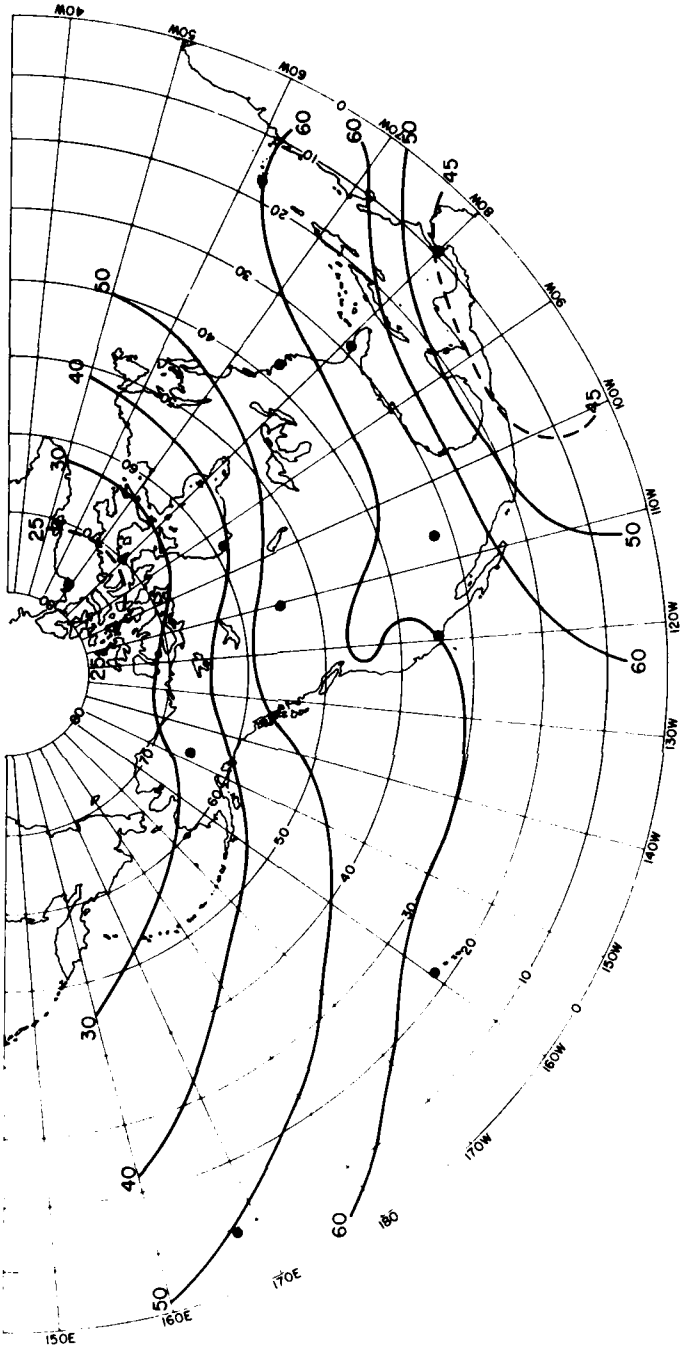

Figure A55. Scalar Speed (m/sec) at 50 km in July, 10-percent Extreme

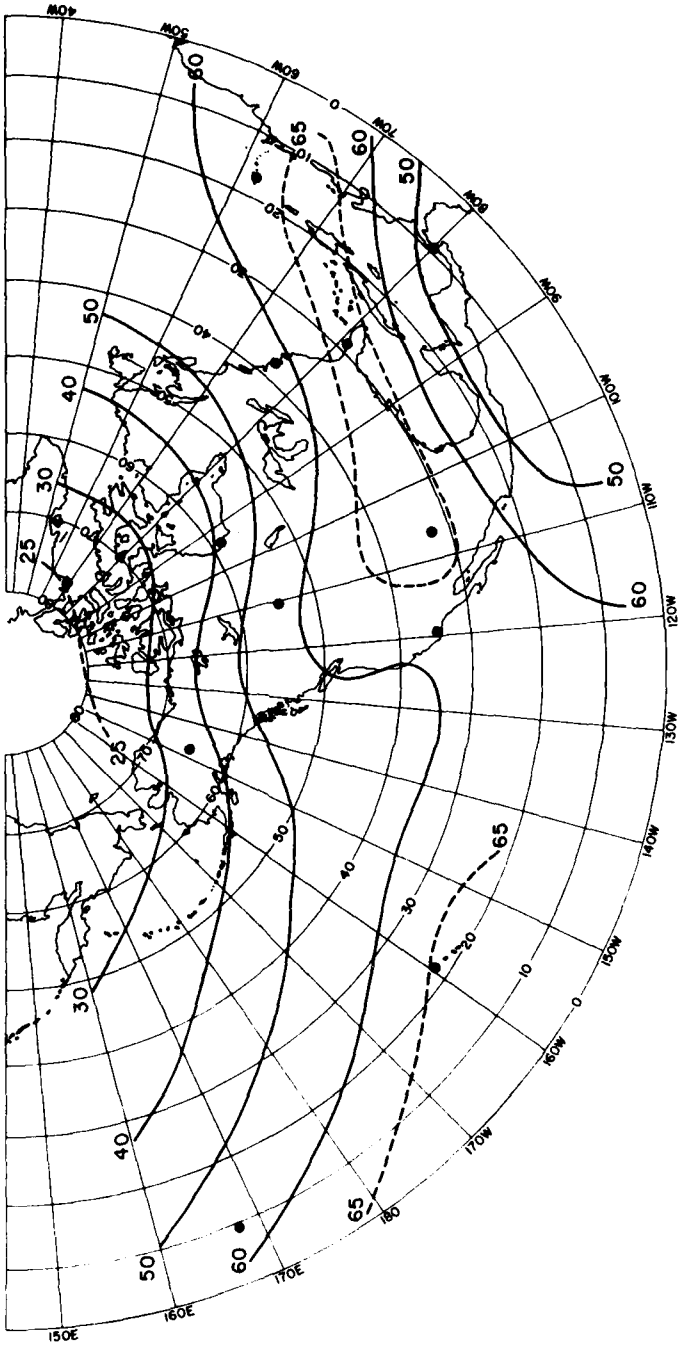

Figure A56. Scalar Speed (m/sec) at 50 km in July, 5-percent Extreme

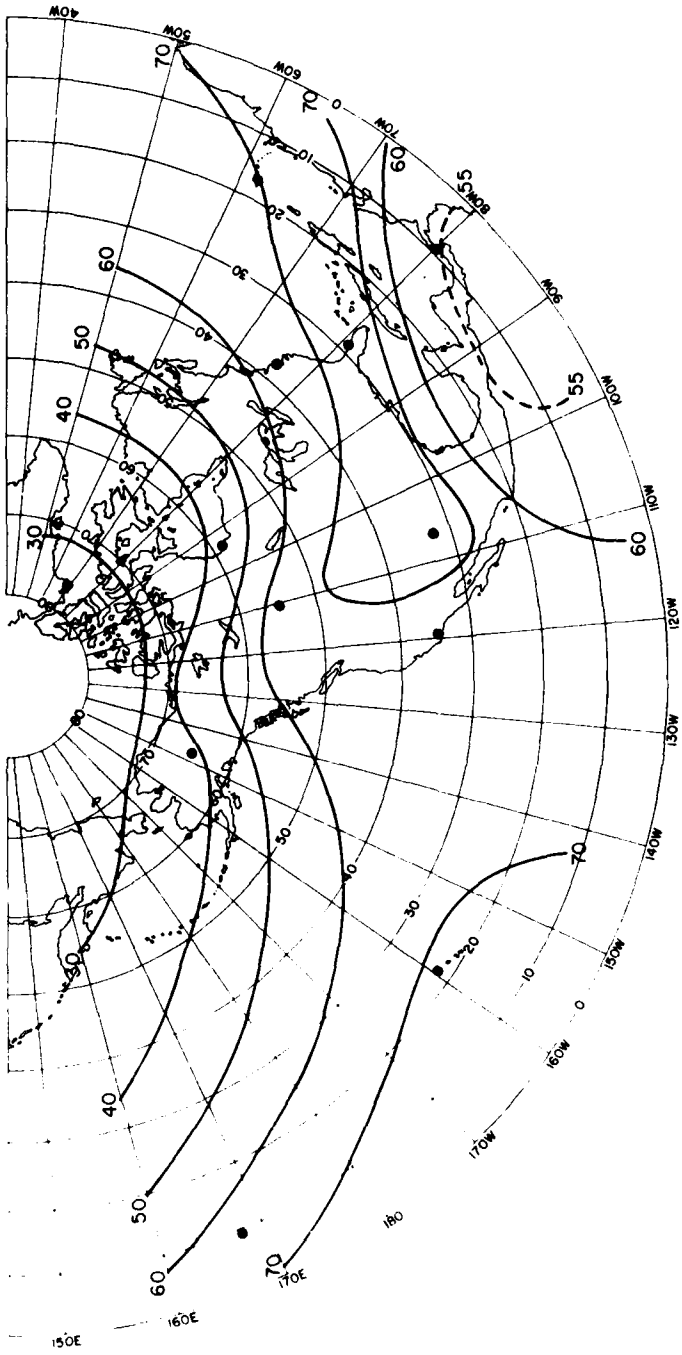

Figure A57. Scalar Speed (m/sec) at 50 km in July, 1-percent Extreme

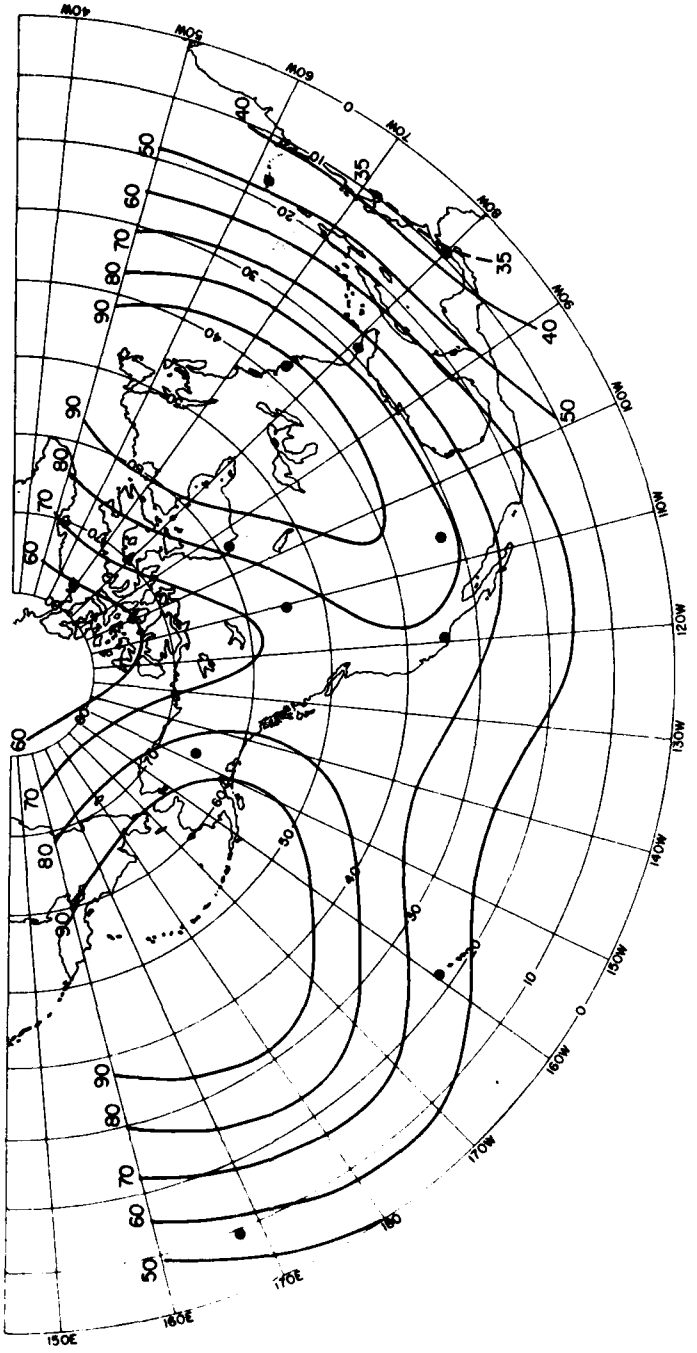

Figure A58. Scalar Speed (m/sec) at 50 km in October, 10-percent Extreme

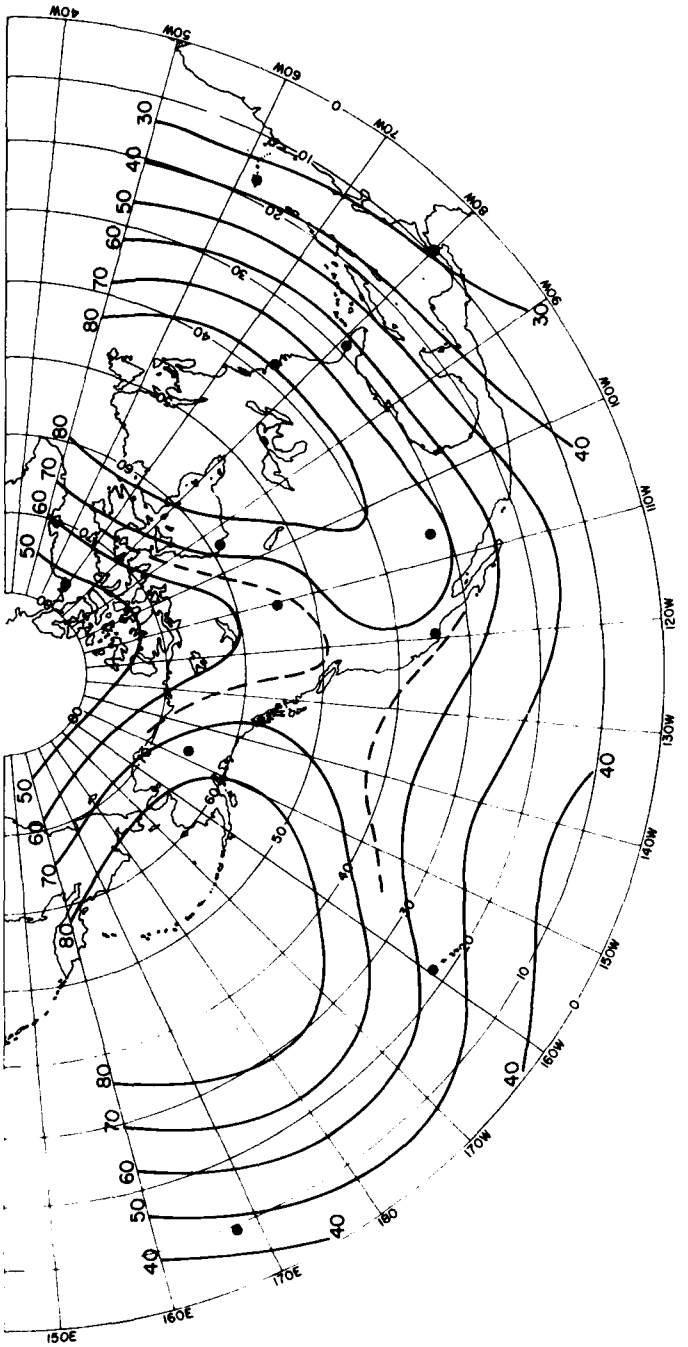

Figure A59. Scalar Speed (m/sec) at 50 km in October, 5-percent Extreme

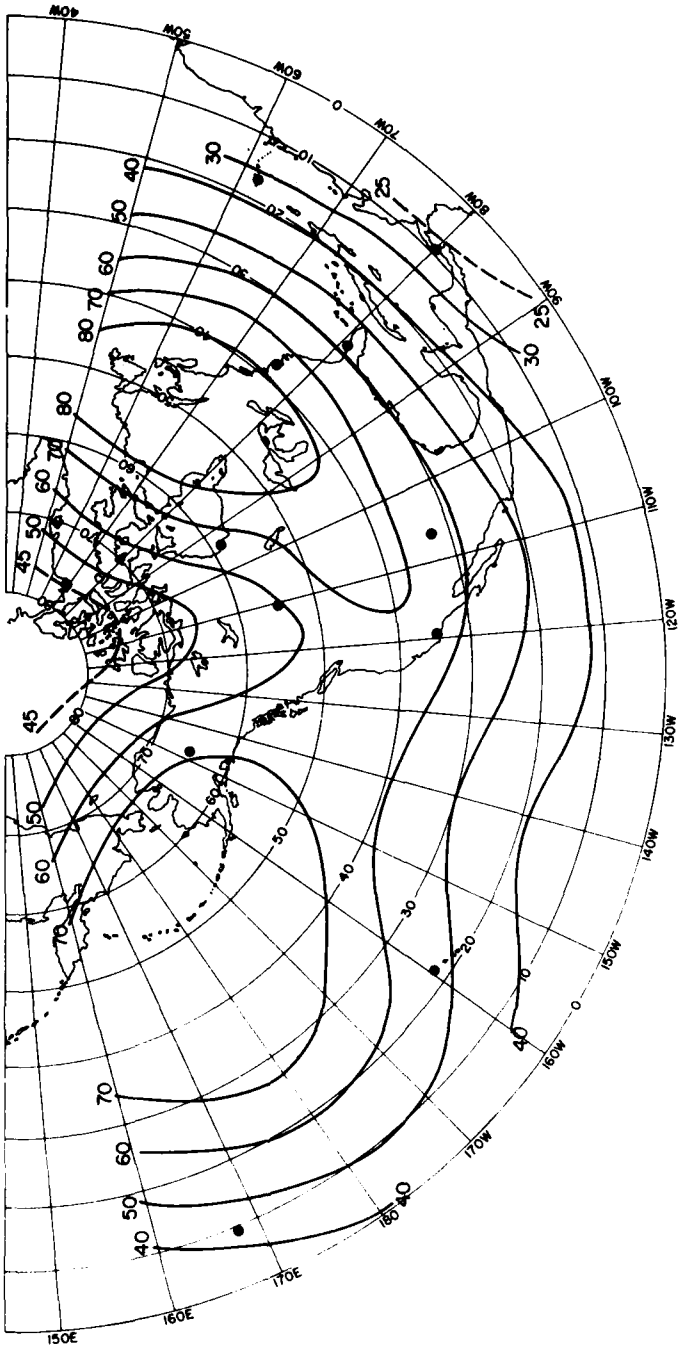

Figure A60. Scalar Speed (m/sec) at 50 km in October, 1-percent Extreme

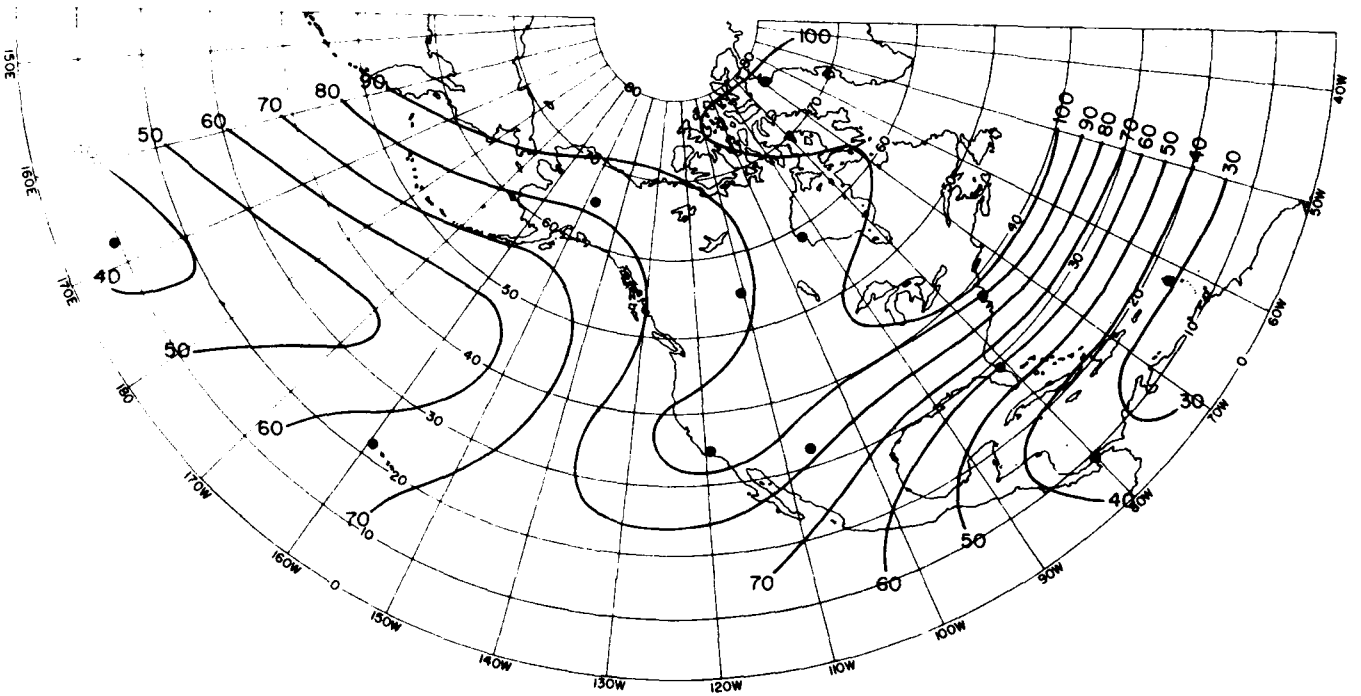

Figure A61. Scalar Speed (m/sec) at 55 km in January, 10-percent Extreme

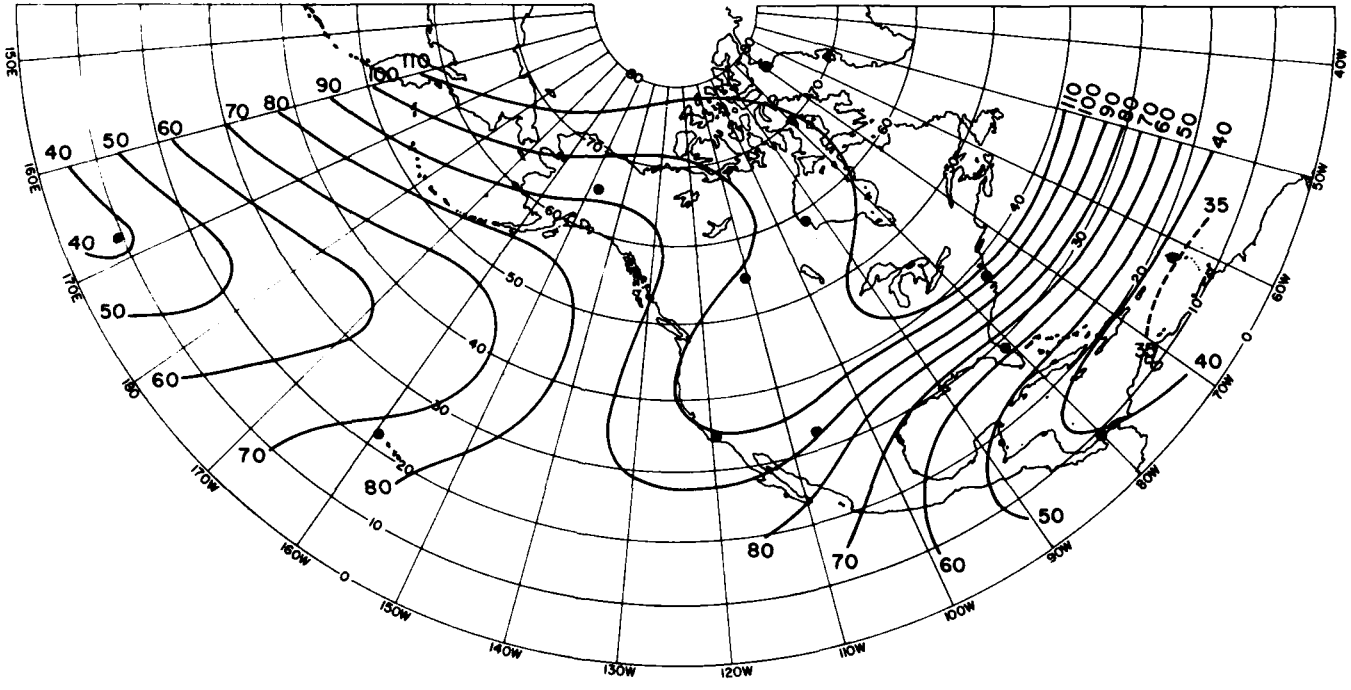

Figure A62. Scalar Speed (m/sec) at 55 km in January, 5-percent Extreme

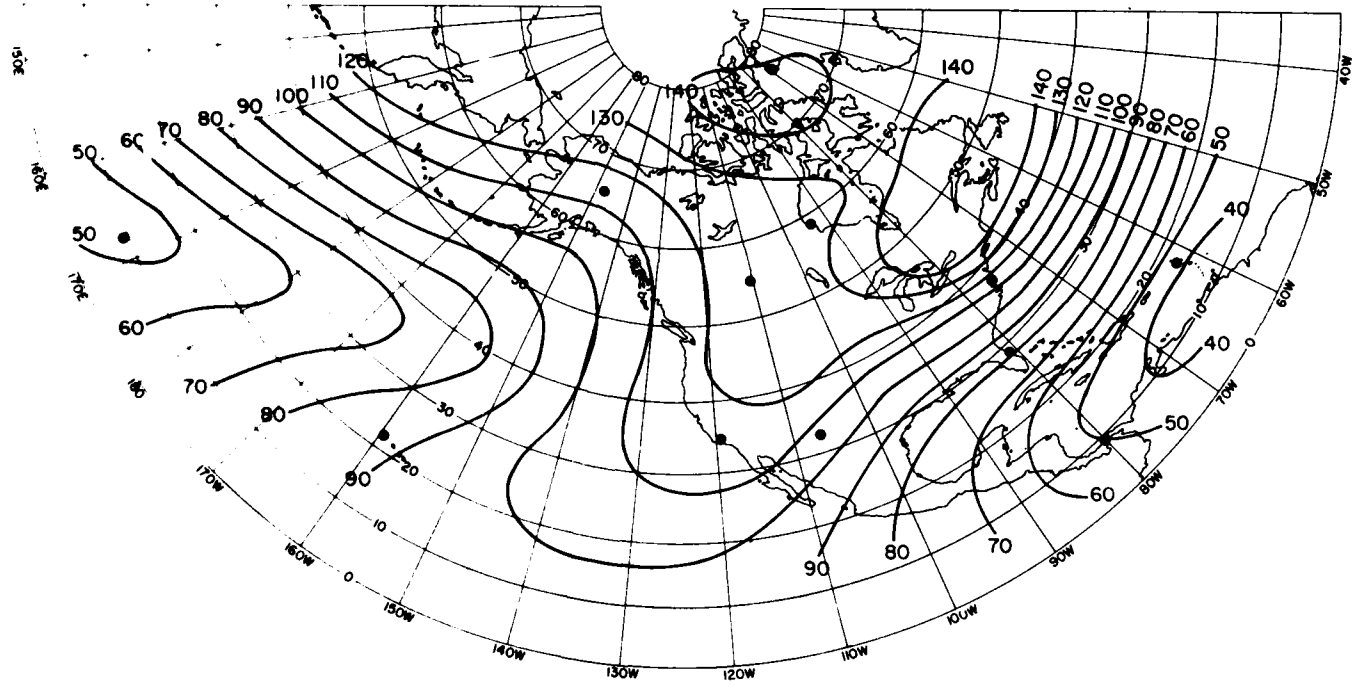

Figure A63. Scalar Speed (m/sec) at 55 km in January, 1-percent Extreme

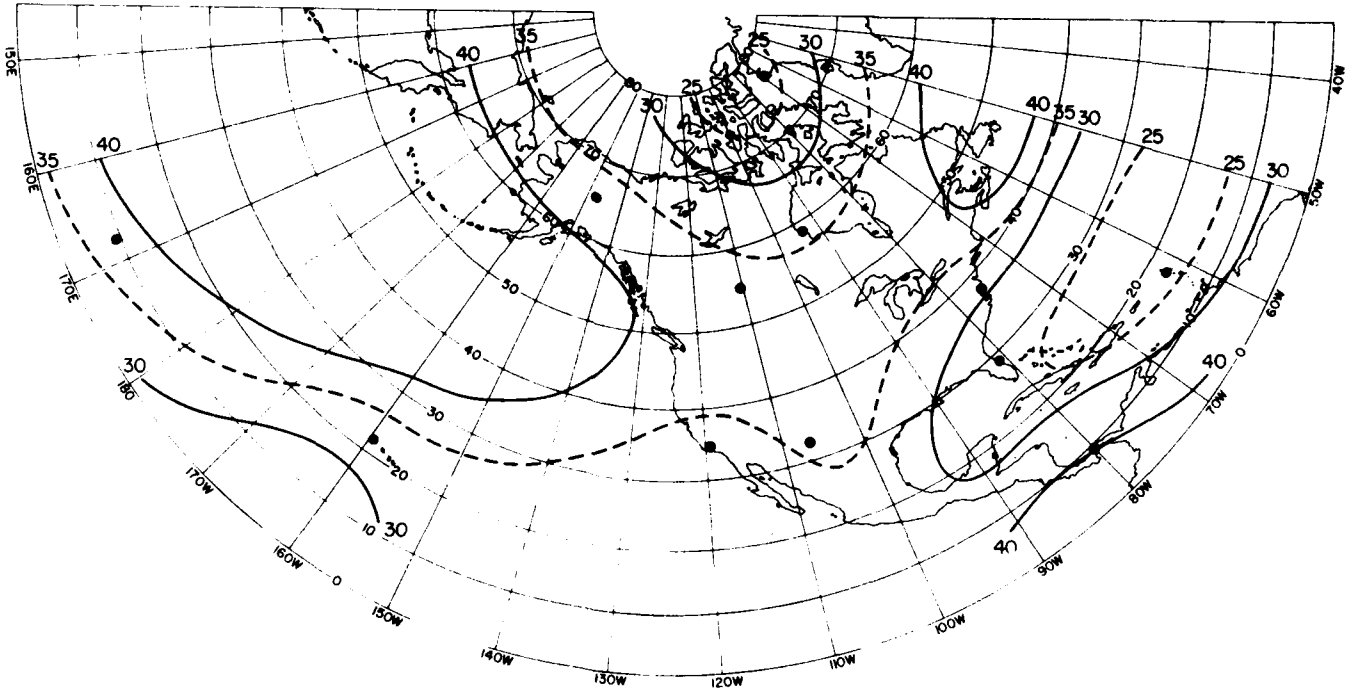

Figure A64. Scalar Speed (m/sec) at 55 km in April, 10-percent Extreme

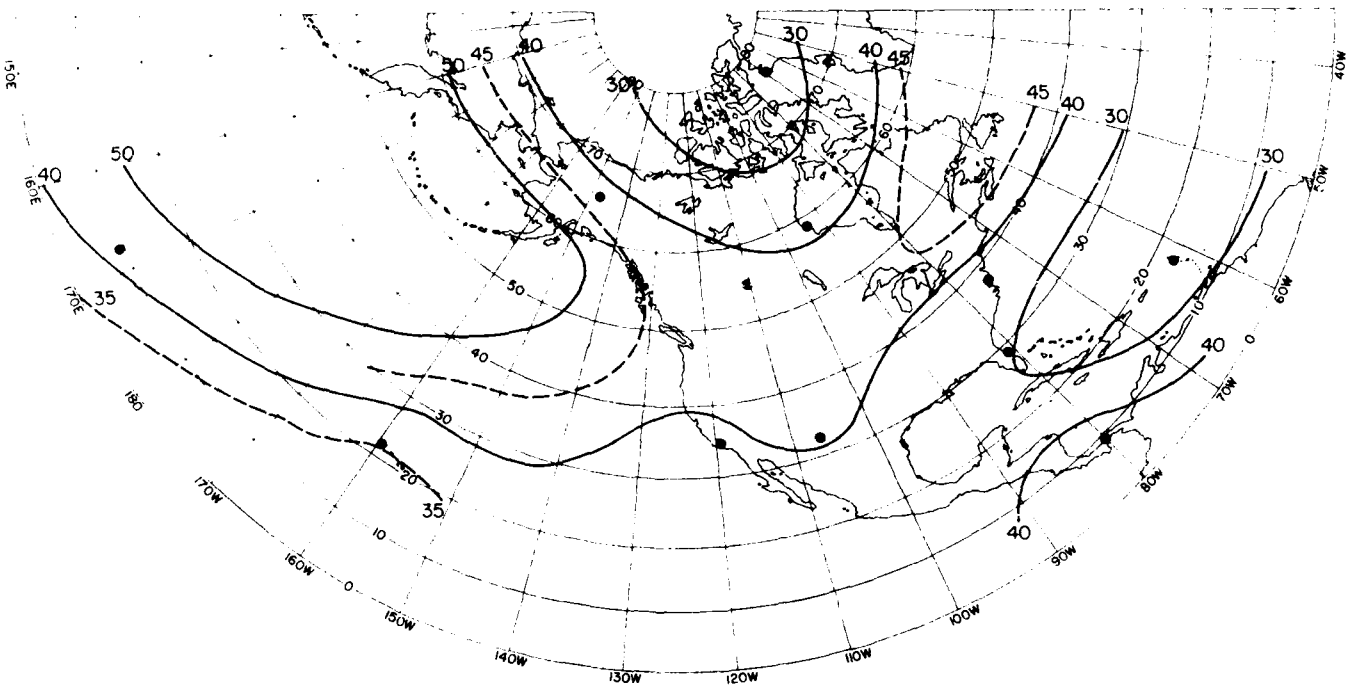

Figure A65. Scalar Speed (m/sec) at 55 km in April, 5-percent Extreme

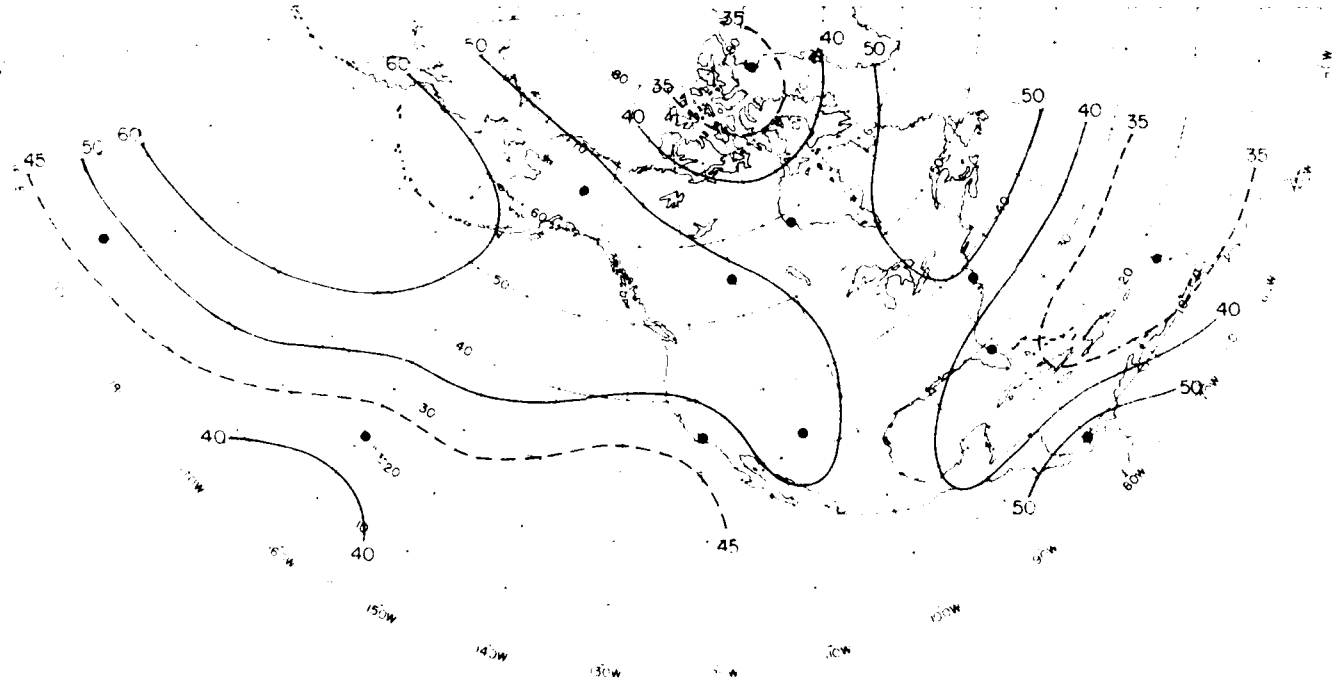

Figure A66. Scalar Speed (m/sec) at 55 km in April, 1-percent Extreme

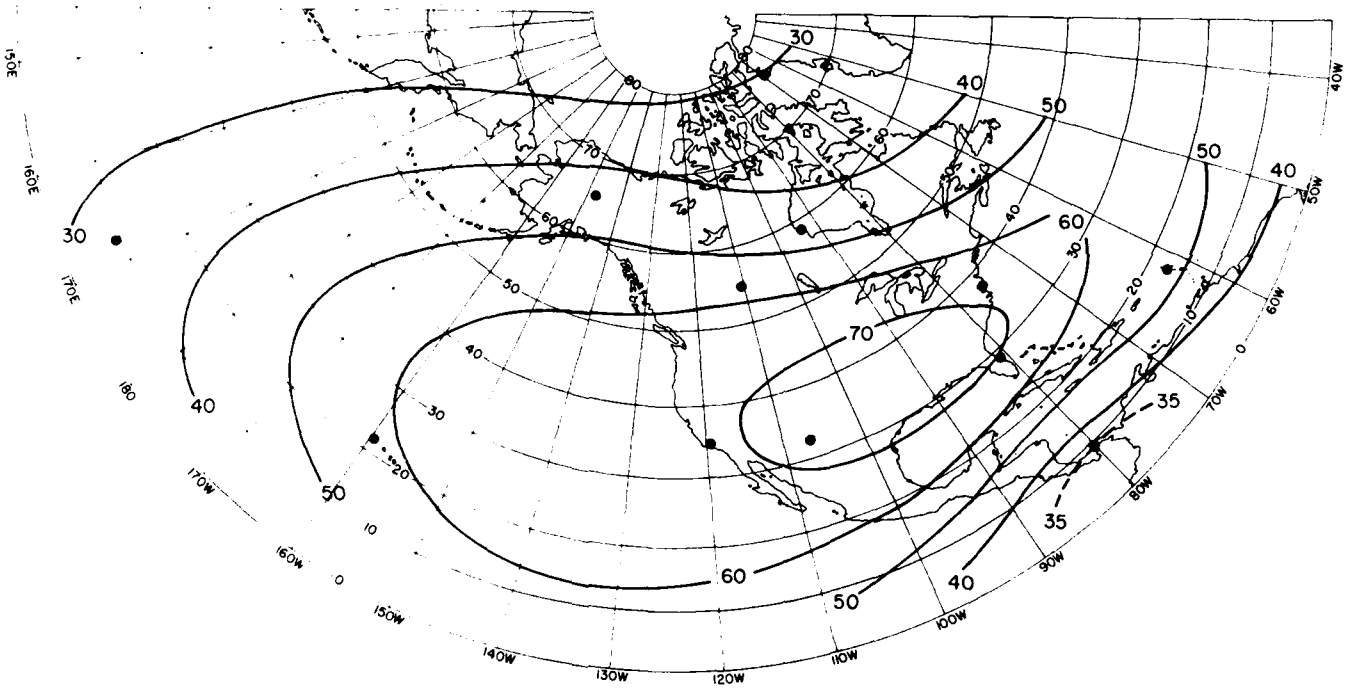

Figure A67. Scalar Speed (m/sec) at 55 km in July, 10-percent Extreme

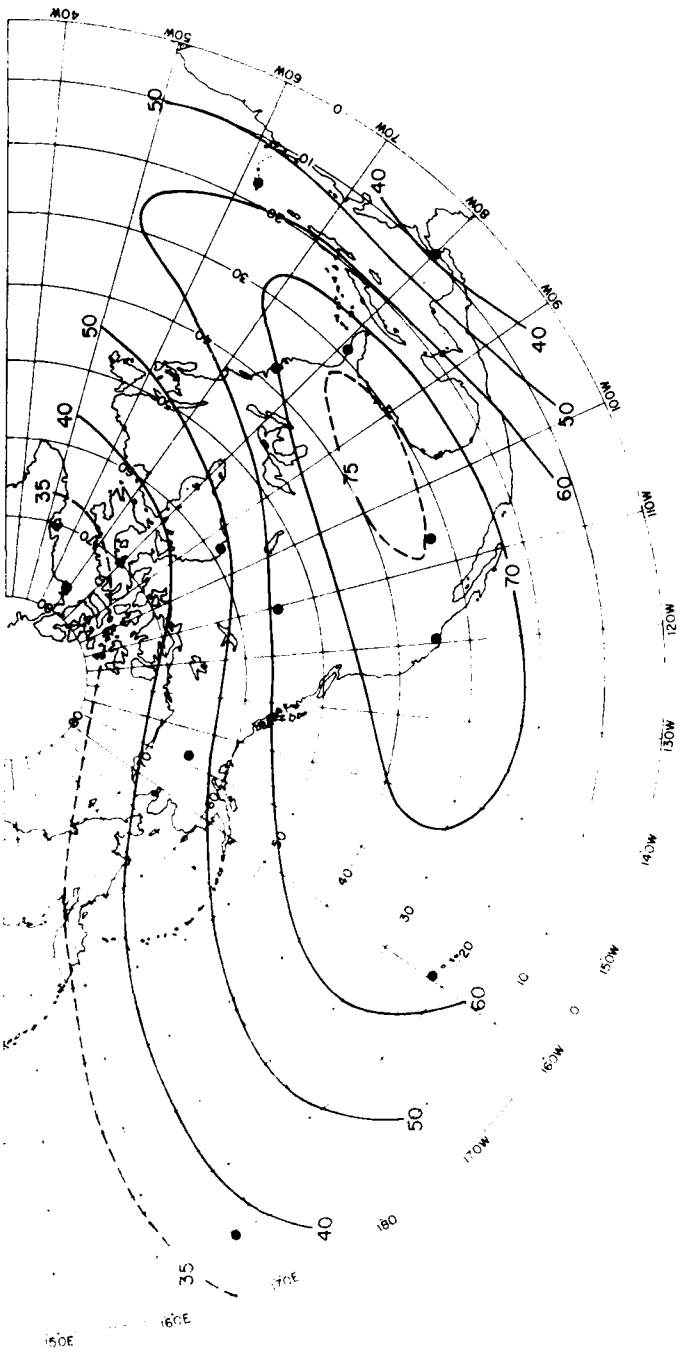

Figure A68. Scalar Speed (m/sec) at 55 km in July, 5-percent Extreme

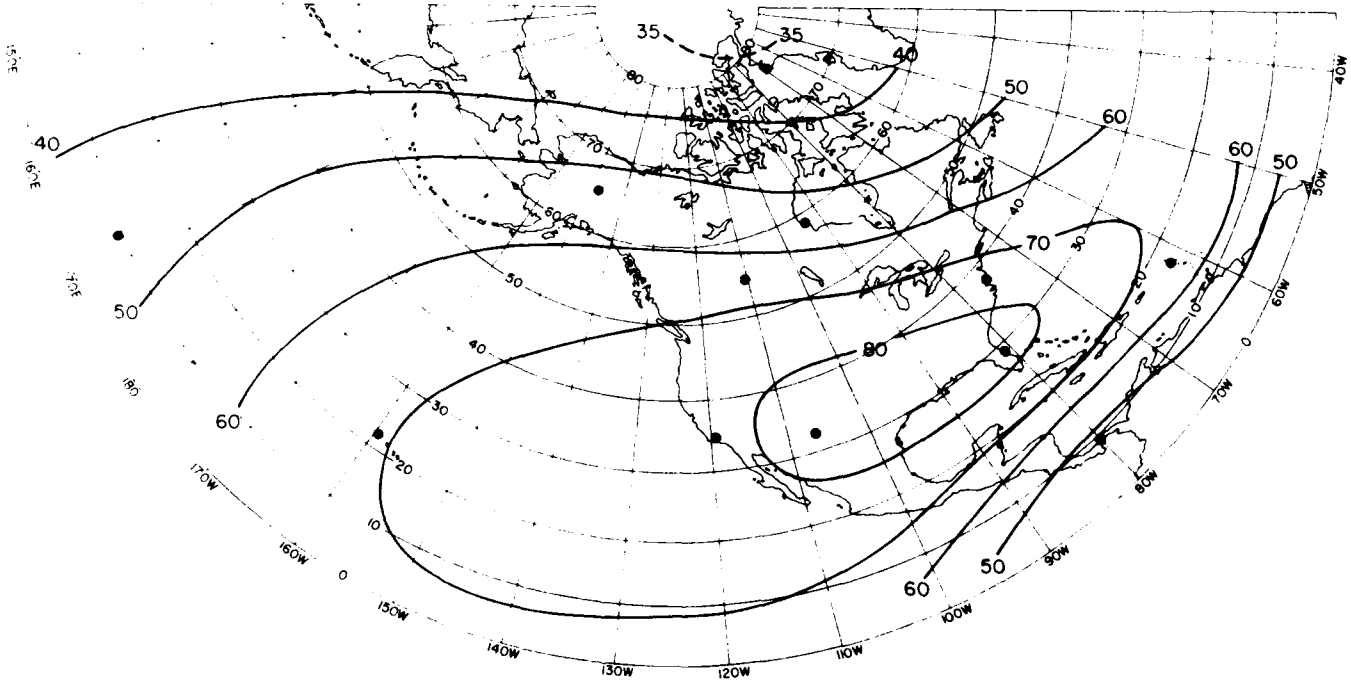

Figure A69. Scalar Speed (m/sec) at 55 km in July, 1-percent Extreme

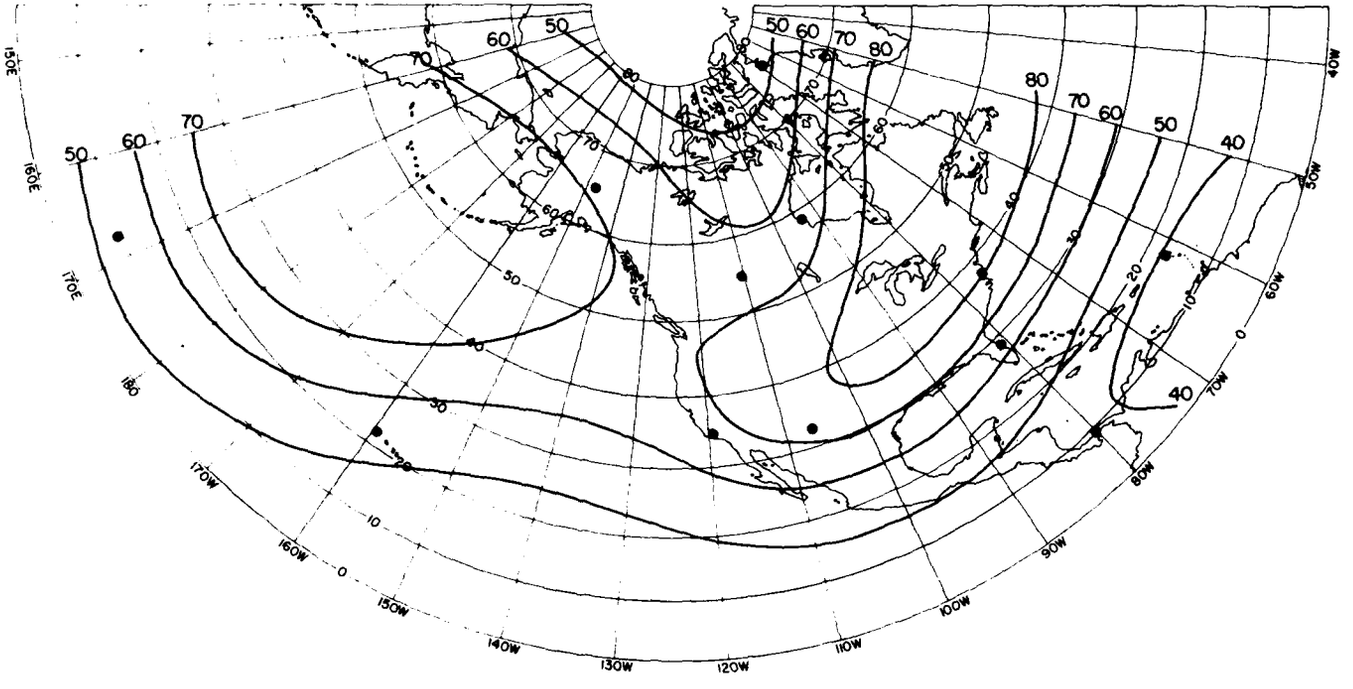

Figure A70. Scalar Speed (m/sec) at 55 km in October, 10-percent Extreme

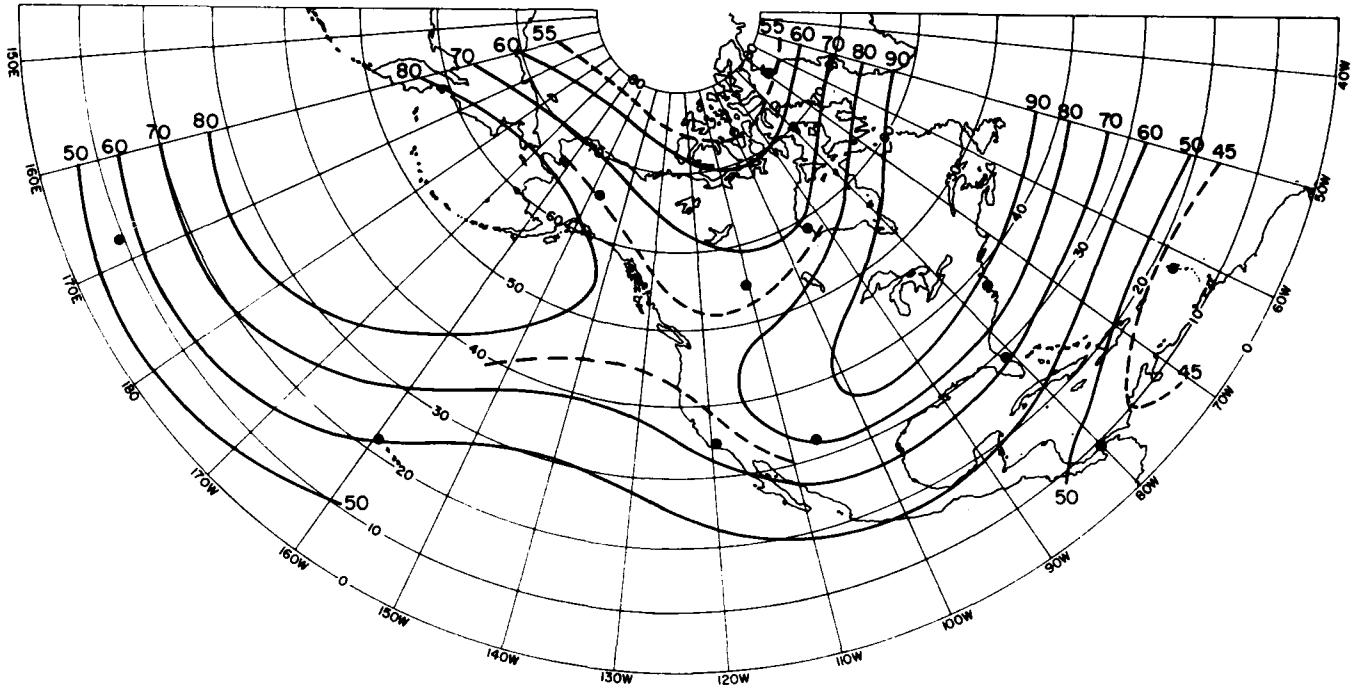

Figure A71. Scalar Speed (m/sec) at 55 km in October, 5-percent Extreme

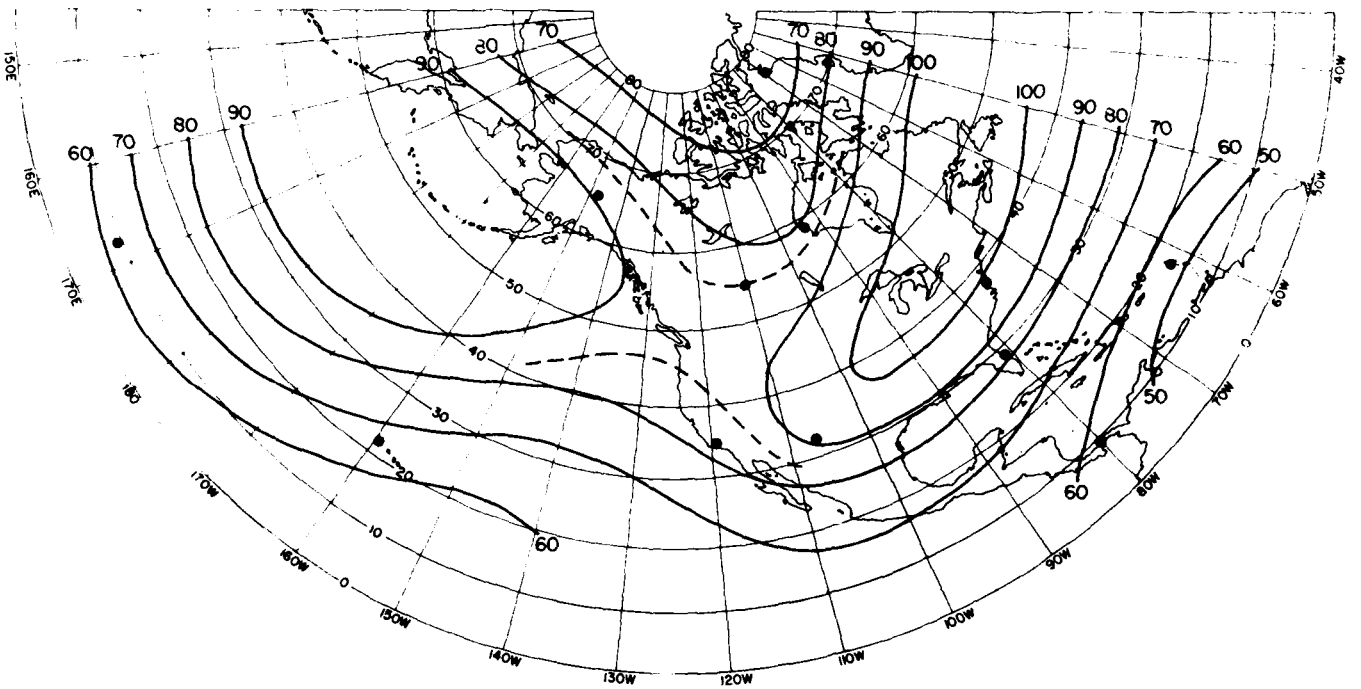

Figure A72. Scalar Speed (m/sec) at 55 km in October, 1-percent Extreme

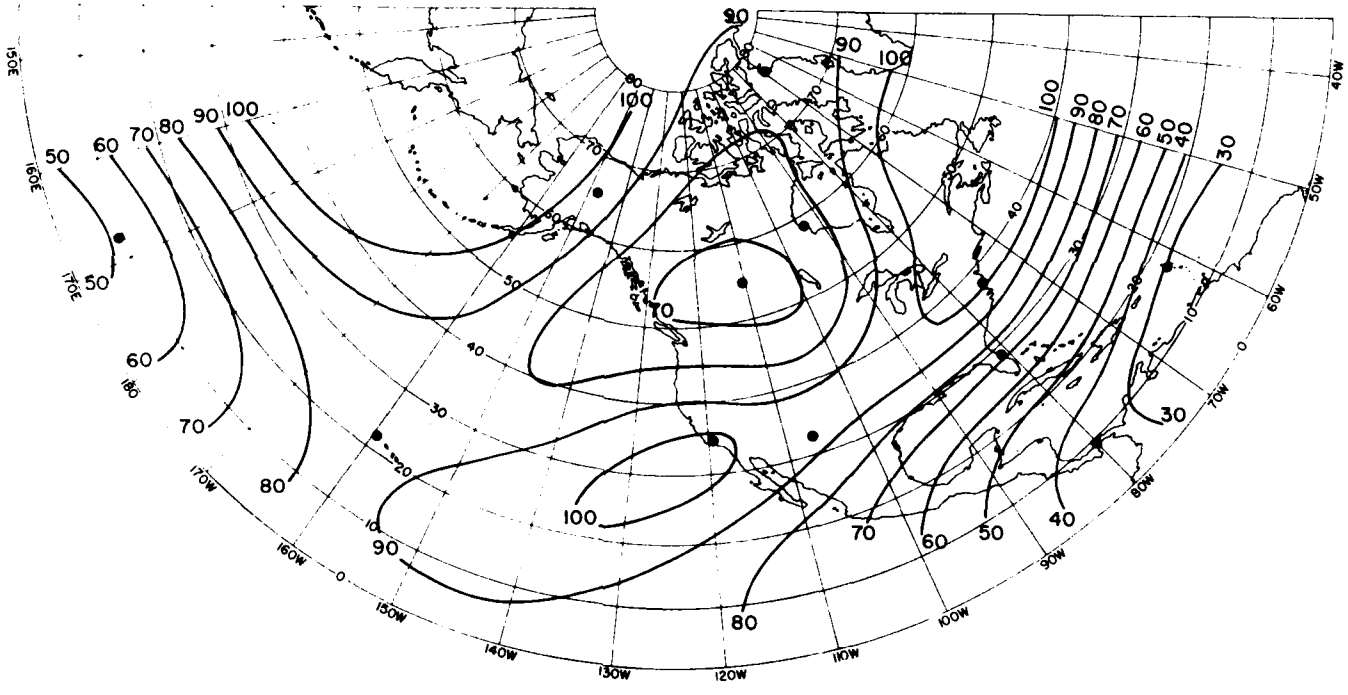

Figure A73. Scalar Speed (m/sec) at 60 km in January, 10-percent Extreme

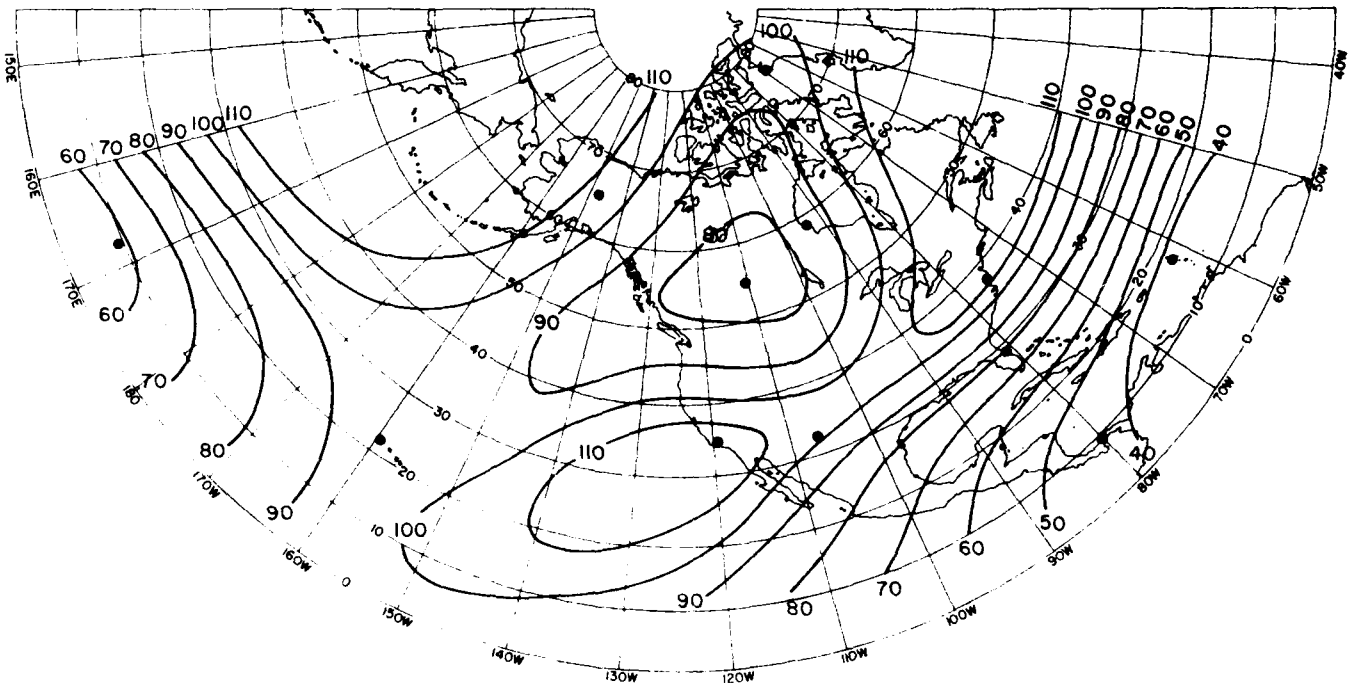

Figure A74. Scalar Speed (m/sec) at 60 km in January, 5-percent Extreme

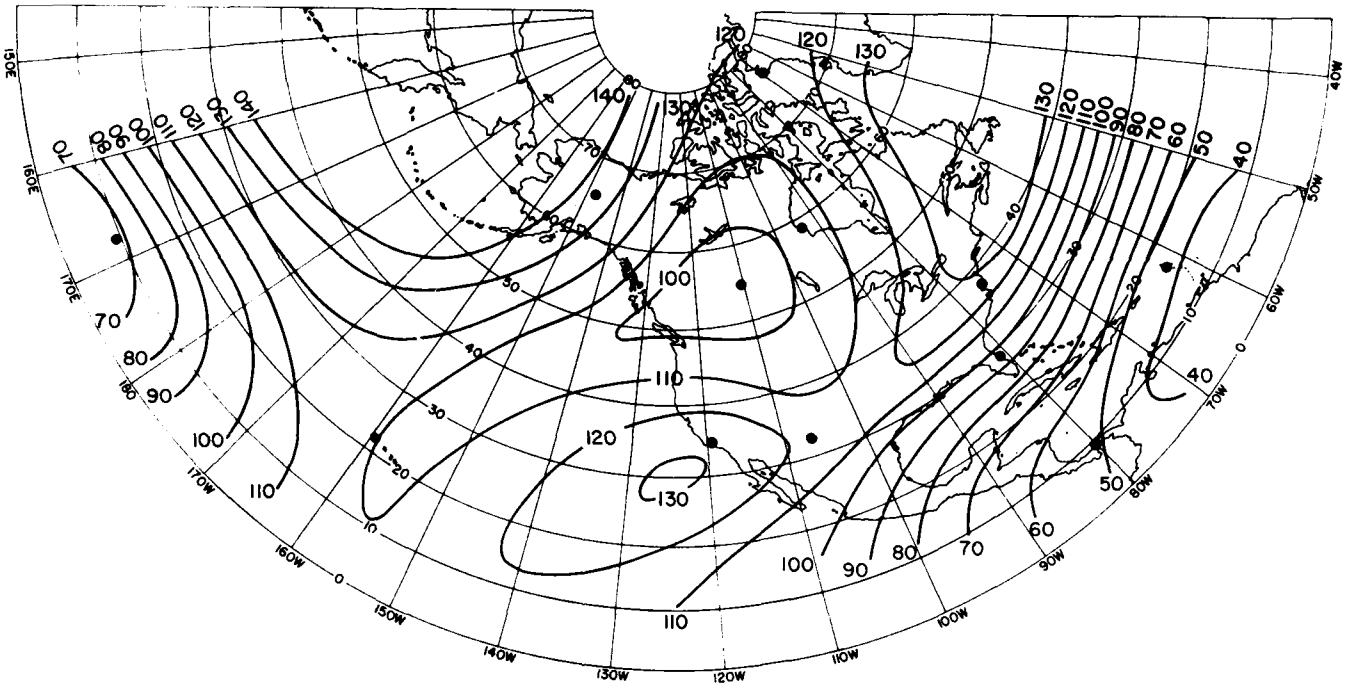

Figure A75. Scalar Speed (m/sec) at 60 km in January, 1-percent Extreme

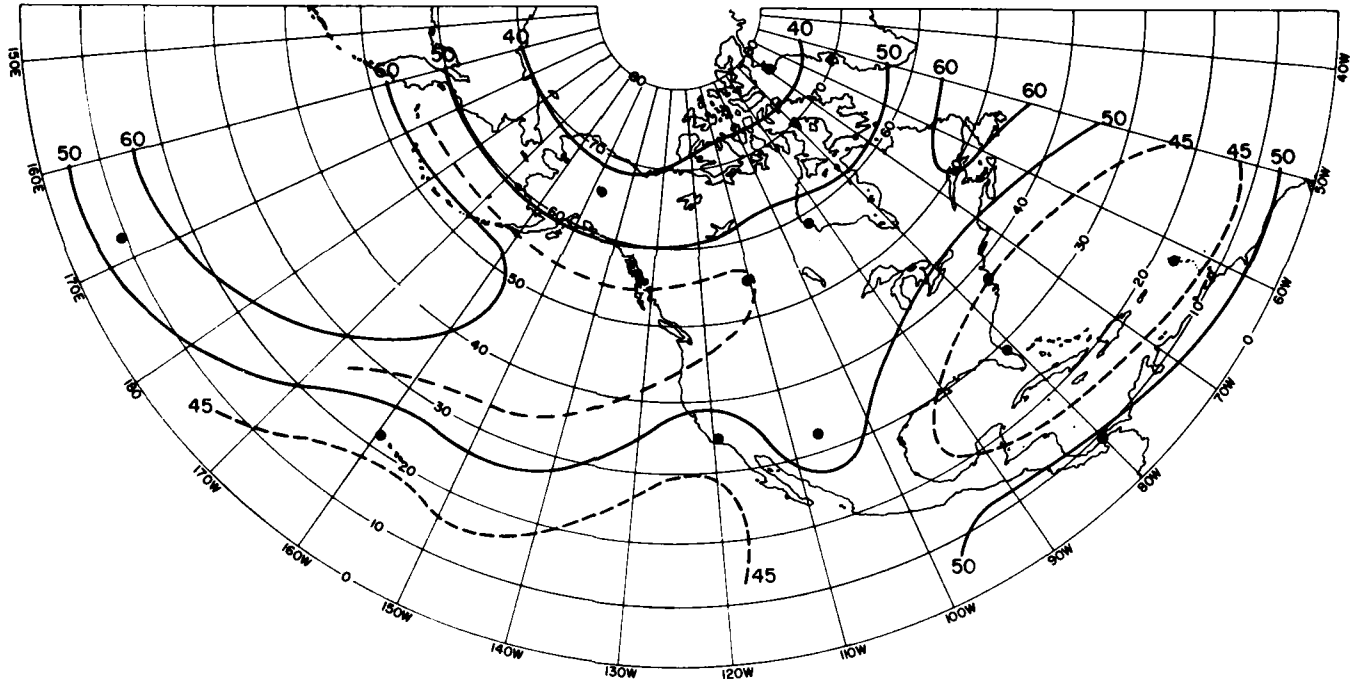

Figure A76. Scalar Speed (m/sec) at 60 km in April, 10-percent Extreme

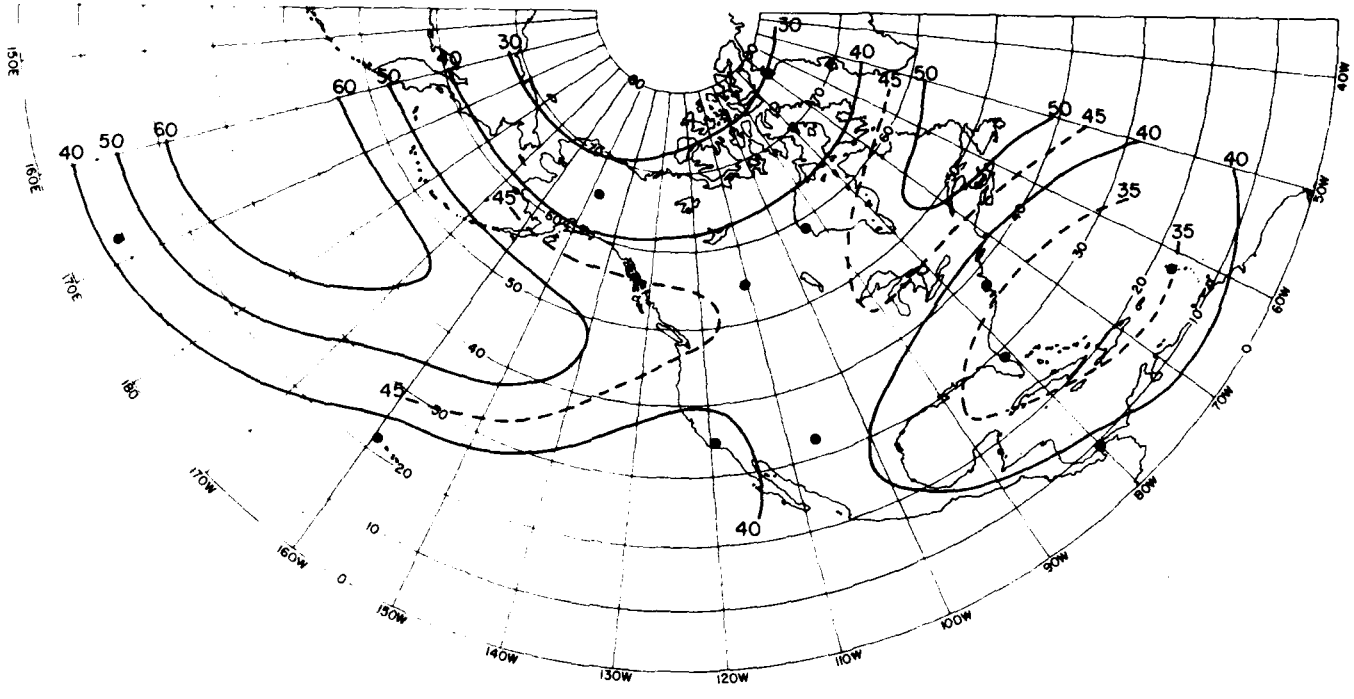

Figure A77. Scalar Speed (m/sec) at 60 km in April, 5-percent Extreme

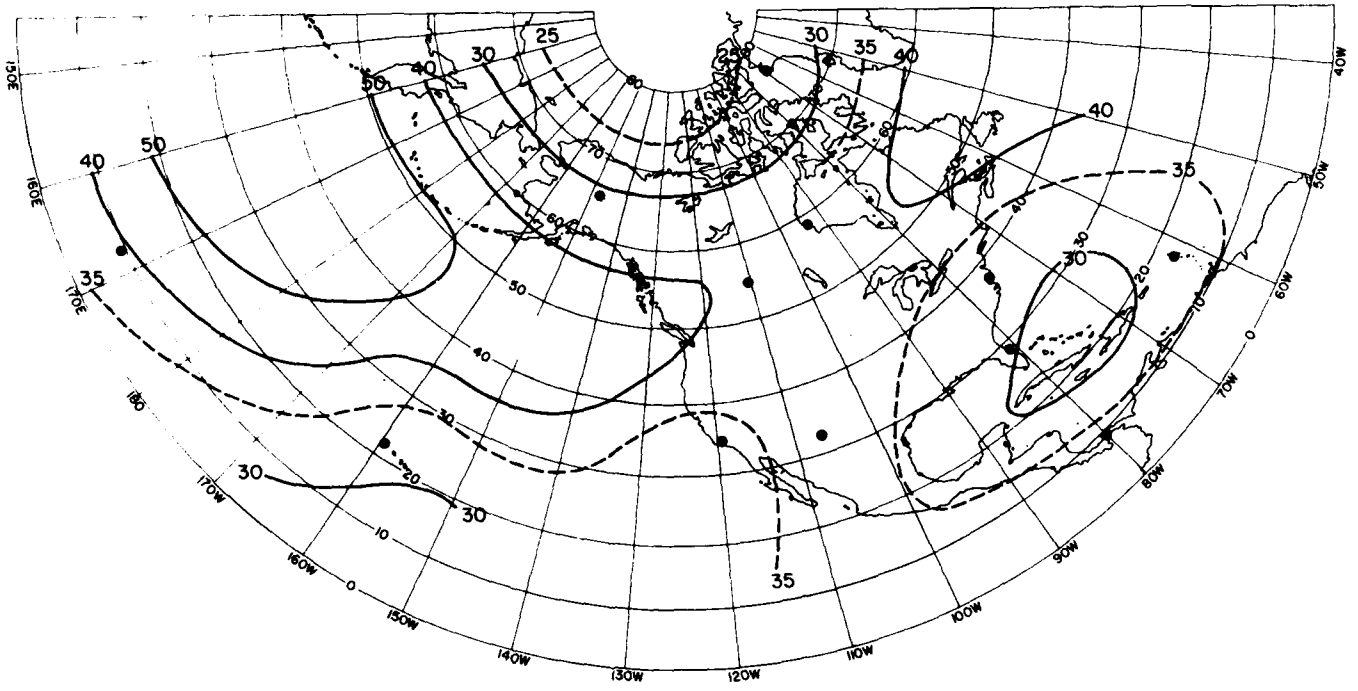

Figure A78. Scalar Speed (m/sec) at 60 km in April, 1-percent Extreme

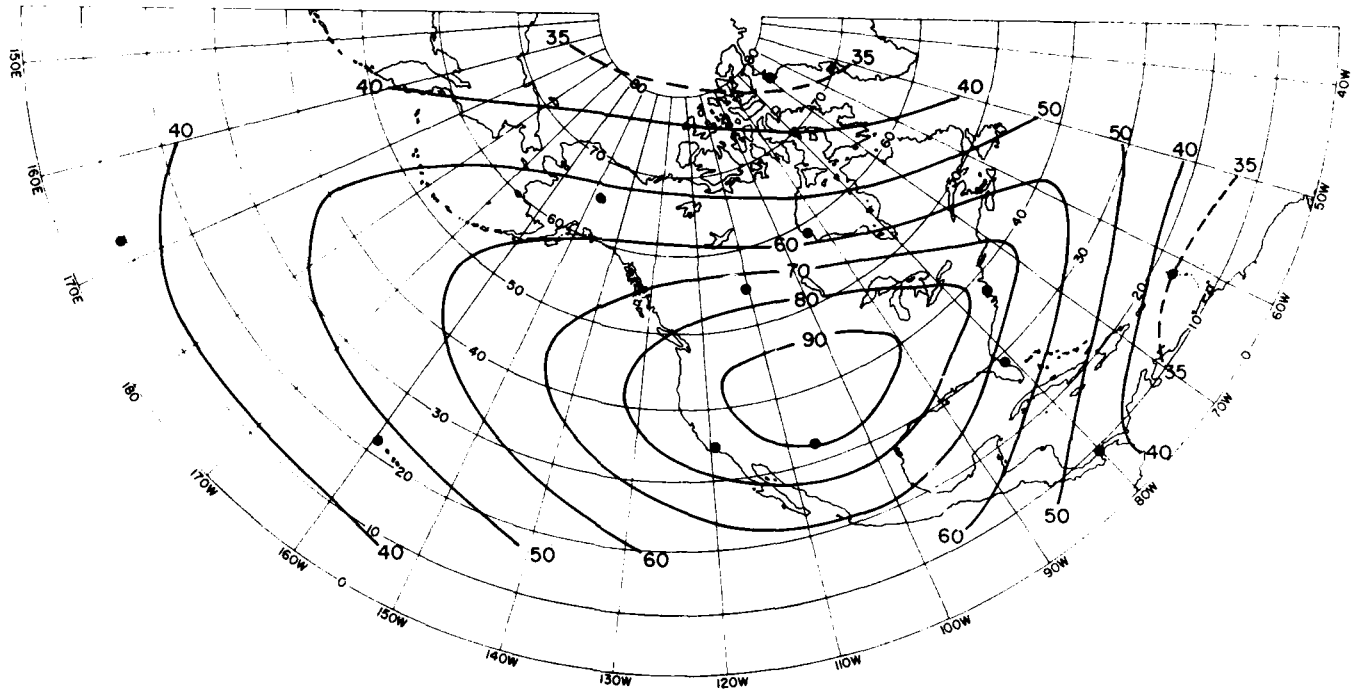

Figure A79. Scalar Speed (m/sec) at 60 km in July, 10-percent Extreme

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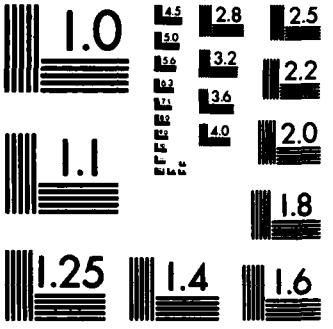


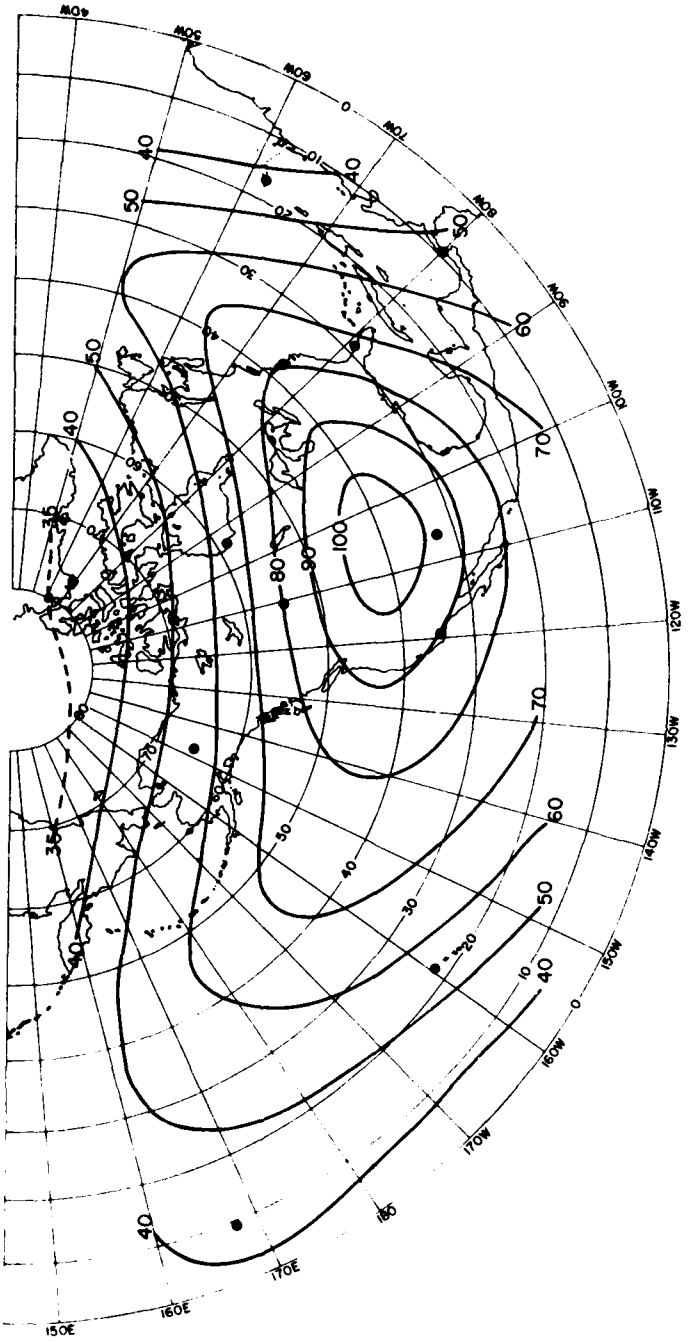


Figure A80. Scalar Speed (m/sec) at 60 km in July, 5-percent Extreme

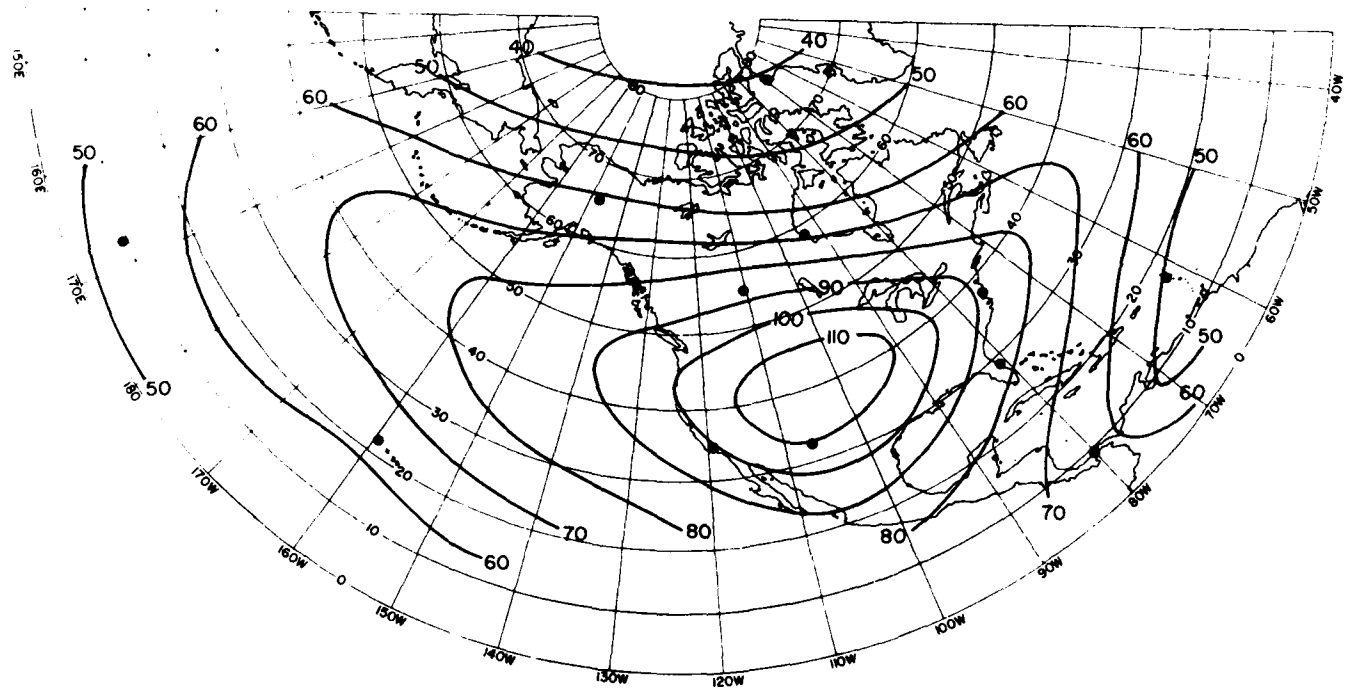


Figure A81. Scalar Speed (m/sec) at 60 km in July, 1-percent Extreme

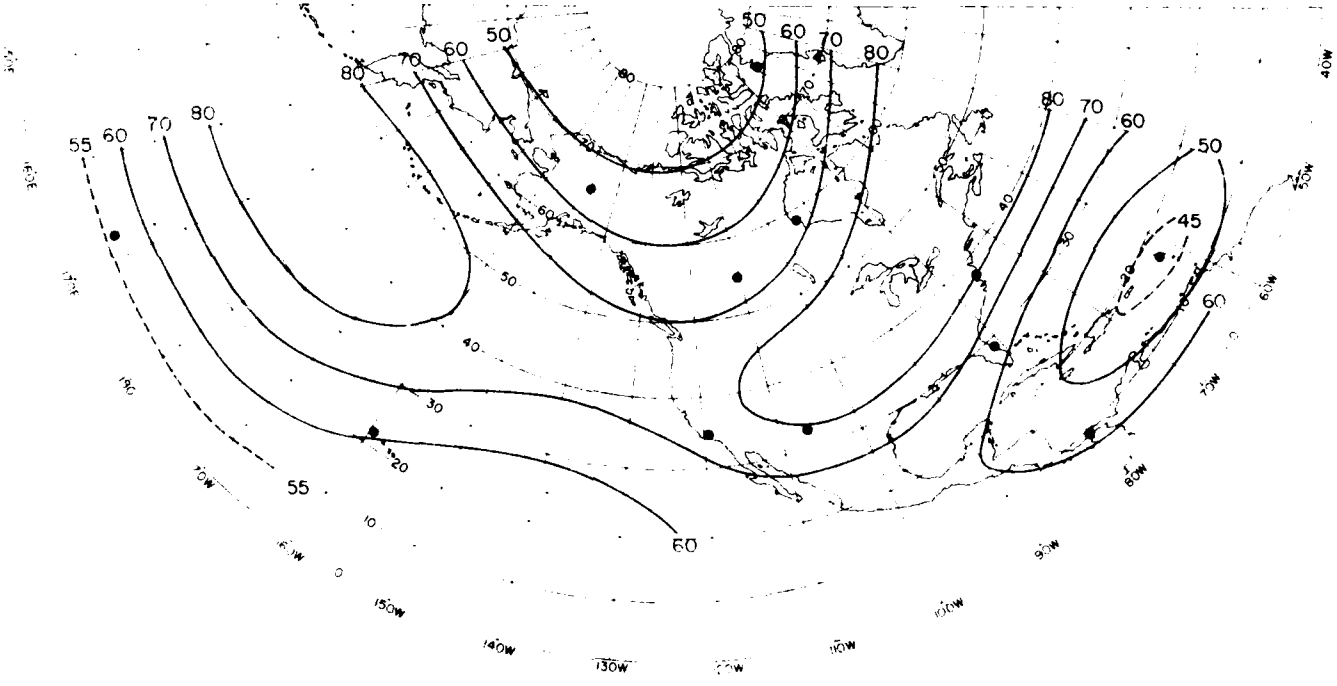


Figure A82. Scalar Speed (m/sec) at 60 km in October, 10-percent Extreme

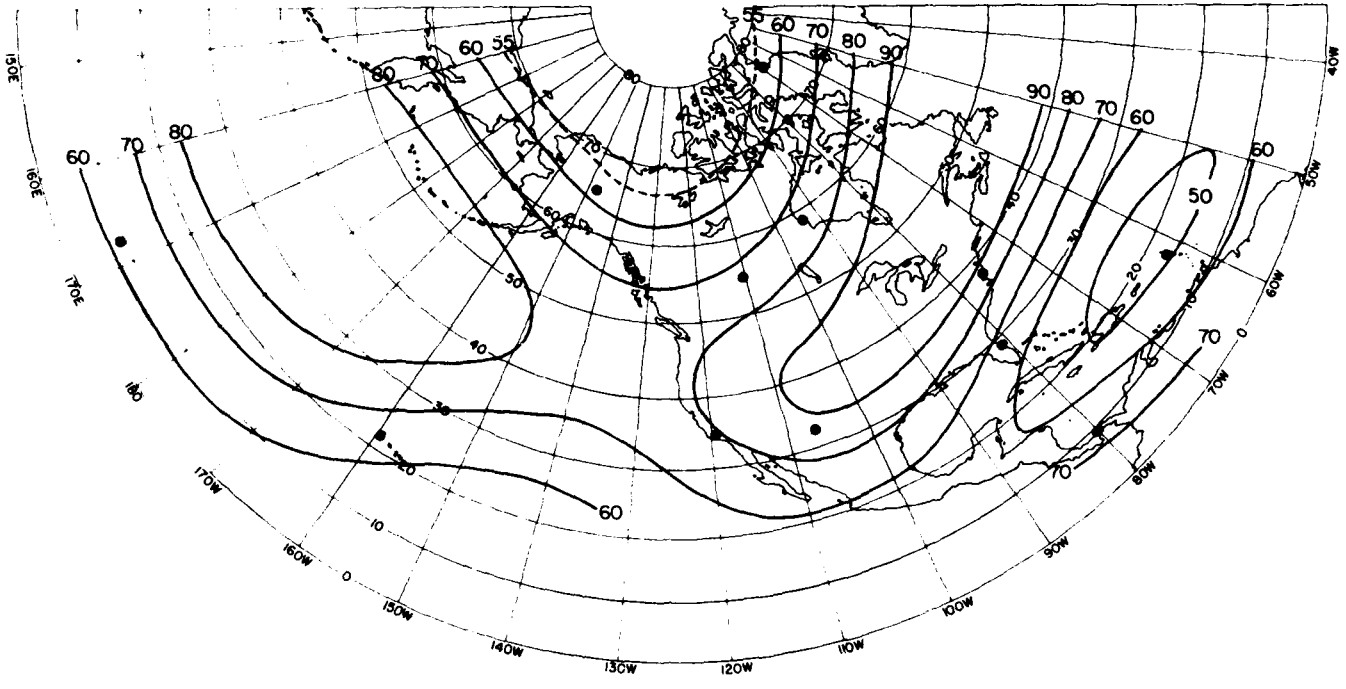


Figure A83. Scalar Speed (m/sec) at 60 km in October, 5-percent Extreme

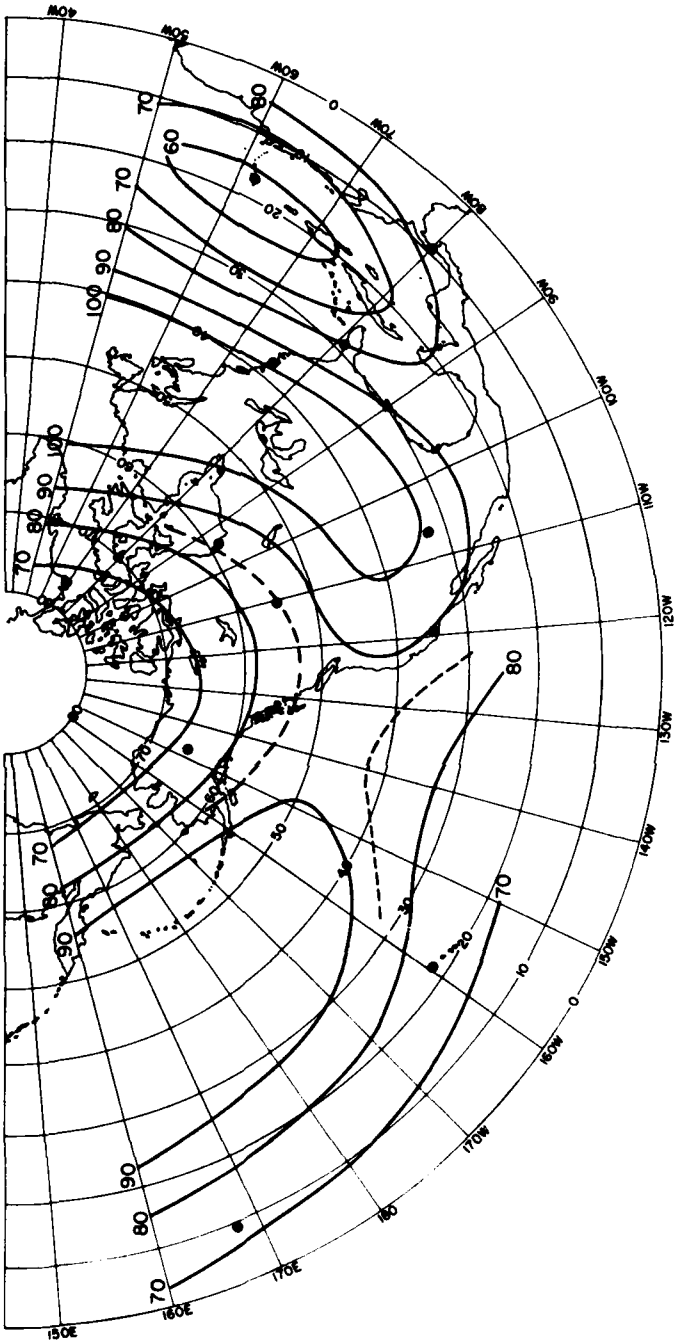


Figure A84. Scalar Speed (m/sec) at 60 km in October, 1-percent Extreme

Appendix B

Tables of 10-, 5-, and 1-percent Wind-Speed Extremes

Table B1. Scalar Extremes (m/sec) at Kwajalein

	30 KM					35 KM					40 KM					45 KM					50 KM					55 KM					60 KM				
MO.	VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT		
	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1
JAN	4	17	27	31	38	6	21	34	39	48	10	15	27	31	38	21	18	40	45	53	22	27	52	59	71	10	21	35	40	50	27	24	53	59	70
FEB	1	18	28	32	40	12	18	33	37	45	16	16	33	37	45	14	18	35	39	48	7	18	29	33	41	24	20	45	50	59	35	22	59	65	75
MAR	8	18	30	35	43	18	14	33	37	44	16	15	33	37	44	8	18	30	34	42	25	19	45	50	59	37	20	58	63	72	32	32	67	75	90
APR	10	15	28	31	38	19	13	32	36	42	10	11	23	26	31	4	12	20	23	29	12	13	27	31	37	22	15	38	42	49	23	16	40	44	52
MAY	15	15	32	36	43	21	11	32	35	40	12	10	23	25	30	6	10	18	20	25	9	14	26	30	36	7	19	31	35	44	7	27	43	49	60
JUN	24	13	37	41	47	24	10	34	37	42	20	11	31	34	39	23	13	36	40	46	28	14	43	46	53	19	20	41	46	56	4	17	27	31	39
JUL	25	11	36	39	45	28	9	37	40	44	31	13	44	47	54	34	16	50	54	62	31	19	51	56	65	14	18	34	39	47	7	24	39	44	54
AUG	25	13	39	42	49	34	12	47	50	56	37	18	55	60	68	31	19	50	55	64	16	18	36	41	49	8	18	30	34	42	2	19	29	33	41
SEP	21	11	32	35	40	26	14	40	44	50	23	19	44	49	58	6	15	24	28	34	4	13	20	23	29	8	18	30	34	42	8	18	31	35	43
OCT	13	12	26	30	35	12	15	29	32	39	0	14	27	30	36	13	13	28	31	38	25	16	42	46	53	35	19	54	59	68	33	22	56	62	72
NOV	8	17	29	33	41	6	19	30	35	43	20	17	39	43	52	29	14	44	47	54	33	18	52	57	65	31	22	54	60	70	28	27	57	64	76
DEC	4	20	31	35	43	8	22	36	41	51	11	18	33	37	46	11	22	37	42	52	6	24	38	44	54	10	30	49	55	68	19	28	51	57	70
ANN	12	19	34	38	46	16	20	38	43	52	13	22	38	44	53	7	24	39	45	55	4	27	42	48	60	11	27	45	51	63	16	28	49	56	69

Table B2. Scalar Extremes (m/sec) at Fort Sherman

	30 KM					35 KM					40 KM					45 KM					50 KM					55 KM					60 KM				
MO.	VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT		
	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1
JAN	2	15	24	27	34	8	15	27	30	37	15	12	29	32	38	26	17	44	48	56	26	24	53	59	70	6	23	36	41	51	6	23	37	42	52
FEB	9	15	27	31	37	17	12	30	33	39	17	14	32	36	42	2	14	21	25	30	7	16	27	31	38	15	20	38	43	53	15	22	40	45	55
MAR	3	13	21	24	29	9	14	25	29	35	12	13	26	29	35	21	15	37	41	49	25	18	44	49	57	7	20	32	37	46	7	19	31	36	44
APR	10	14	26	30	36	16	12	29	32	38	7	12	22	25	31	7	11	20	23	28	13	15	29	33	40	16	21	40	45	54	14	20	37	42	51
MAY	17	14	32	36	43	21	11	32	35	41	8	13	24	27	33	6	8	16	18	22	9	13	25	28	34	7	18	29	34	42	9	26	41	47	58
JUN	22	11	33	36	42	23	11	34	37	42	19	14	34	38	44	23	12	35	38	44	29	15	45	49	56	21	22	46	52	62	7	25	39	45	56
JUL	26	10	36	39	44	26	12	38	41	47	27	13	40	44	50	30	15	46	50	57	25	17	43	48	56	13	20	36	40	49	11	28	46	53	65
AUG	23	11	34	37	42	28	13	42	45	52	29	19	49	53	62	21	17	40	44	52	11	16	29	33	41	7	16	27	31	38	8	20	33	37	46
SEP	24	11	35	38	43	20	12	33	36	42	11	14	27	30	37	1	11	16	19	23	6	10	18	20	25	8	14	24	28	34	9	17	29	33	41
OCT	9	16	28	32	39	3	16	25	28	35	4	13	22	25	31	9	13	24	28	34	11	14	27	30	36	13	22	44	49	59	21	34	60	68	84
NOV	5	13	22	25	31	0	14	26	29	35	9	12	22	25	31	7	20	32	36	45	8	16	27	31	38	11	27	45	51	63	7	27	42	48	59
DEC	8	13	23	26	32	1	13	20	23	29	4	14	23	26	32	17	20	40	44	54	23	26	52	58	70	8	21	34	39	48	7	30	47	54	67
ANN	14	16	31	35	43	15	16	33	37	45	13	18	33	37	45	11	20	35	40	49	10	23	39	44	54	6	23	37	42	52	6	26	41	46	57

Table B3. Scalar Extremes (m/sec) at Antigua

	30 KM					35 KM					40 KM					45 KM					50 KM					55 KM					60 KM				
MO.	VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT		
	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1
JAN	3	13	21	24	29	9	14	25	29	35	12	13	26	29	35	21	15	37	41	49	25	18	44	49	57	7	20	32	37	46	7	19	31	36	44
FEB	5	11	18	21	26	2	12	19	21	27	12	11	24	27	32	12	15	30	34	41	7	21	33	38	47	18	20	41	46	55	29	16	46	50	57
MAR	4	12	19	22	27	13	12	27	30	36	15	15	32	36	43	3	17	27	30	38	10	18	31	35	43	21	17	39	44	52	30	20	51	56	66
APR	9	9	19	22	26	12	10	22	25	30	10	11	22	25	30	4	11	18	20	25	5	14	23	26	32	12	11	24	27	32	16	15	32	36	43
MAY	16	8	24	27	31	19	7	26	28	32	17	8	26	28	32	20	9	29	32	36	21	12	34	37	43	20	12	32	35	41	8	18	31	35	44
JUN	25	5	30	32	35	26	8	34	37	41	24	10	34	37	41	32	12	44	47	52	36	14	50	54	60	29	16	46	50	57	17	16	34	38	46
JUL	29	7	35	37	41	34	7	41	43	47	36	11	47	50	55	44	13	57	60	67	46	14	60	63	70	33	19	53	58	67	9	22	37	42	51
AUG	30	5	35	36	38	36	7	43	45	49	36	14	50	54	60	36	18	55	59	68	28	20	50	55	65	10	17	30	34	42	5	17	27	31	39
SEP	25	5	30	32	34	22	9	32	34	39	13	15	29	33	40	9	13	23	27	32	4	11	19	21	26	7	13	23	26	32	9	12	23	26	32
OCT	14	7	21	23	27	8	14	24	27	33	4	13	20	23	29	12	12	26	29	35	17	14	33	36	43	23	16	40	44	52	25	19	45	50	59
NOV	7	8	16	18	22	2	15	23	26	32	14	15	31	35	42	20	18	39	43	52	22	20	43	48	57	22	22	46	52	62	28	32	64	72	86
DEC	3	10	16	18	23	2	15	23	26	33	2	17	26	29	36	6	19	30	35	43	9	20	33	38	46	9	21	35	40	50	15	22	40	46	56
ANN	14	14	29	33	40	16	17	34	38	46	13	19	35	40	48	12	23	40	45	56	9	26	43	49	60	7	25	40	46	57	13	25	43	49	60

Table B4. Scalar Extremes (m/sec) at Barking Sands

	30 KM					35 KM					40 KM					45 KM					50 KM					55 KM					60 KM				
MO.	VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT		
	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1
JAN	6	13	21	24	30	8	17	28	32	40	4	18	29	33	41	4	24	37	42	52	9	29	47	54	66	29	33	65	73	88	56	31	88	95	110
FEB	11	11	23	26	31	10	13	25	29	35	3	20	32	36	45	10	24	40	46	56	20	26	49	55	67	37	25	64	70	82	56	20	76	82	91
MAR	8	10	19	21	26	6	11	20	23	28	3	14	22	25	31	17	18	37	42	50	29	20	51	56	65	39	22	61	67	77	43	24	68	74	85
APR	2	10	15	17	22	5	11	19	21	26	4	11	18	20	25	4	14	22	25	32	8	16	27	31	38	9	18	32	36	44	11	20	34	39	48
MAY	11	7	19	21	24	12	8	21	23	27	15	9	24	26	31	24	10	33	36	41	24	11	36	39	44	28	14	42	46	53	28	14	43	47	54
JUN	21	6	26	28	31	23	7	30	32	35	31	7	38	40	44	40	9	49	51	56	43	11	54	57	63	46	15	60	64	71	41	16	57	62	69
JUL	27	4	31	32	35	31	6	37	39	42	40	8	47	49	53	49	9	58	61	66	51	11	62	66	71	40	17	58	62	70	24	23	49	54	65
AUG	28	4	32	33	36	31	6	37	38	42	36	9	45	48	53	38	13	51	54	60	30	17	47	52	60	16	16	33	37	45	7	16	27	30	37
SEP	22	6	28	29	32	19	9	28	30	35	13	11	25	28	34	11	12	25	29	34	5	11	19	22	27	7	11	21	33	29	7	15	25	29	35
OCT	9	6	16	17	20	3	11	18	20	25	17	13	31	34	40	26	15	42	46	53	35	17	53	58	66	38	18	56	61	69	40	21	61	66	76
NOV	8	7	16	18	22	20	13	34	37	44	31	15	46	50	57	47	14	61	65	72	58	18	75	80	89	62	19	81	85	94	62	24	86	92	103
DEC	5	10	17	19	24	11	16	29	33	40	21	21	45	50	60	33	28	63	70	83	37	31	70	78	92	42	33	77	85	101	49	33	84	92	108
ANN	7	16	27	31	38	6	20	32	37	46	6	26	41	47	58	7	34	53	60	74	7	38	59	67	83	12	40	64	73	90	21	41	70	80	98

Table B5. Scalar Extremes (m/sec) at Cape Kennedy

	30 KM					35 KM					40 KM					45 KM					50 KM					55 KM					60 KM				
MO.	VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT		
	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1
JAN	11	13	26	29	36	19	17	38	42	50	15	20	37	42	51	14	24	42	48	58	16	27	47	54	66	25	28	57	64	77	42	27	71	77	90
FEB	14	12	27	30	36	18	16	36	40	47	12	20	35	40	49	15	22	40	46	55	22	25	50	56	67	34	23	59	65	76	51	24	75	81	92
MAR	10	10	21	24	29	16	15	32	36	43	12	17	32	36	43	16	21	40	45	54	24	22	48	54	64	31	22	54	60	71	39	24	64	70	81
APR	4	9	15	18	22	7	13	23	26	32	5	13	21	24	30	4	13	21	24	30	5	16	25	29	35	5	17	27	31	38	5	19	30	35	43
MAY	5	7	14	16	19	3	9	14	16	20	9	9	18	21	25	19	9	29	31	36	24	11	35	38	43	27	12	39	43	49	30	13	44	47	54
JUN	17	12	30	33	39	18	12	31	34	40	28	13	41	44	50	39	14	53	57	64	41	17	58	63	71	47	20	68	73	82	54	16	70	74	82
JUL	25	5	30	31	34	28	6	34	36	39	36	7	43	45	49	49	10	59	61	66	52	11	63	67	72	53	16	70	74	82	45	21	67	72	82
AUG	25	6	30	32	35	26	7	33	34	38	30	9	39	42	46	40	11	51	54	60	39	17	56	60	68	27	20	49	54	63	18	22	43	48	58
SEP	17	7	24	25	29	11	9	20	23	27	10	12	24	27	32	11	13	26	29	35	7	17	28	32	39	6	15	24	28	35	9	16	28	32	39
OCT	3	7	12	14	18	7	12	21	24	29	15	15	32	36	43	25	18	45	49	58	35	22	58	63	73	40	23	65	71	82	37	23	61	66	77
NOV	13	12	26	29	35	29	16	45	50	57	42	16	59	63	71	55	17	72	77	85	66	19	85	90	99	70	20	90	95	105	64	22	87	93	103
DEC	22	12	34	37	42	34	16	49	54	61	36	19	55	60	69	36	26	64	70	83	36	28	66	73	86	38	32	72	80	95	45	31	78	86	101
ANN	2	18	28	32	40	4	24	37	42	52	3	28	43	50	61	5	35	55	62	77	8	40	62	70	87	11	42	67	76	94	15	44	71	81	100

Table B6. Scalar Extremes (m/sec) at White Sands

	30 KM					35 KM					40 KM					45 KM					50 KM					55 KM					60 KM				
MO.	VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT		
	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1
JAN	9	18	30	35	43	15	23	42	48	59	19	25	47	53	65	30	30	63	71	84	42	36	80	89	106	46	34	82	91	107	59	34	94	103	119
FEB	9	17	29	33	41	22	24	49	55	66	27	28	58	65	77	31	30	64	71	85	40	28	70	77	90	48	32	82	90	105	59	29	89	96	110
MAR	9	12	23	27	32	22	17	40	44	52	27	21	50	55	65	31	24	56	62	73	34	22	58	63	74	38	23	62	68	79	41	30	73	80	94
APR	8	8	17	19	23	15	11	27	30	36	13	17	32	36	44	12	18	33	37	45	9	19	33	37	46	6	23	36	41	51	7	23	37	43	53
MAY	1	7	11	12	16	0	15	28	32	38	7	11	19	22	27	16	16	34	39	46	20	13	34	37	43	24	14	38	42	48	30	17	48	52	60
JUN	14	9	23	26	30	17	10	27	30	34	24	10	34	37	42	34	11	45	48	53	40	12	53	56	62	48	14	62	66	73	54	20	75	80	90
JUL	22	6	28	29	32	25	7	32	34	38	33	8	41	44	48	44	10	54	57	62	50	12	62	66	72	56	15	71	75	82	62	28	91	98	111
AUG	21	5	26	27	30	23	7	30	32	35	28	13	41	44	50	37	12	50	53	59	39	16	55	59	67	38	21	60	65	75	31	26	59	65	77
SEP	11	9	20	23	27	7	8	16	19	23	9	11	21	24	29	11	13	26	29	36	6	17	27	31	38	6	17	28	32	39	9	19	30	34	42
OCT	6	11	19	22	27	17	16	34	38	46	24	19	45	50	59	30	21	53	58	68	41	25	67	73	85	50	24	75	81	93	53	27	81	88	101
NOV	18	13	32	36	42	32	17	50	54	62	44	16	60	64	71	56	20	76	81	91	71	26	97	103	116	78	30	106	116	130	76	33	108	115	130
DEC	12	18	33	38	46	33	24	58	64	76	52	25	78	84	95	68	27	95	102	115	75	31	107	115	130	77	32	109	118	131	77	33	111	118	134
ANN	1	18	27	31	39	7	26	41	47	58	9	33	52	59	73	11	41	65	74	92	15	47	76	86	106	16	51	82	94	116	18	55	84	97	125

Table B7. Scalar Extremes (m/sec) at Point Mugu

	30 KM					35 KM					40 KM					45 KM					50 KM					55 KM					60 KM				
MO.	VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT		
	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1
JAN	5	18	29	33	40	13	26	44	50	61	21	29	54	61	74	37	34	73	81	97	50	37	90	99	117	56	34	92	100	116	64	37	102	112	129
FEB	4	15	24	28	34	15	26	45	51	63	25	32	62	70	84	34	36	73	82	98	38	32	73	81	96	48	29	78	85	99	61	28	90	97	111
MAR	8	13	23	26	32	21	19	42	46	55	32	25	59	65	76	37	23	61	67	78	39	22	62	68	78	41	22	64	69	80	44	26	71	78	91
APR	7	8	16	18	22	16	11	28	30	36	17	17	36	40	48	13	19	34	39	47	13	20	37	42	51	8	21	34	39	48	4	22	34	39	48
MAY	1	6	9	10	13	1	7	11	13	16	7	9	18	20	25	15	10	23	28	33	20	11	31	34	40	26	12	39	42	48	33	16	50	54	62
JUN	13	5	18	19	22	17	6	23	25	28	26	7	33	35	39	34	8	42	44	49	41	11	52	55	60	48	12	63	63	68	54	14	68	72	78
JUL	22	4	26	27	30	25	5	30	32	35	33	6	39	41	44	44	8	52	54	58	51	10	61	63	68	56	13	69	73	79	61	23	84	90	100
AUG	21	4	25	27	29	22	6	28	30	33	27	9	36	39	43	35	9	44	47	51	38	14	52	56	62	36	18	55	60	68	31	22	54	60	70
SEP	10	6	16	17	20	7	7	15	17	20	9	9	19	21	25	11	11	23	26	31	9	13	24	27	33	6	13	22	25	31	4	15	24	28	34
OCT	8	10	20	22	27	18	13	32	36	42	27	16	43	48	55	32	18	51	56	64	43	20	63	68	77	49	19	68	73	83	53	21	74	80	90
NOV	16	14	31	34	41	28	18	47	52	61	40	20	61	66	75	51	20	71	76	86	65	25	91	97	109	71	26	97	104	116	62	29	92	99	113
DEC	5	18	29	33	41	22	28	53	60	73	42	30	74	82	96	61	33	95	103	119	74	35	118	119	136	79	35	114	123	140	76	41	118	128	148
ANN	1	16	25	29	36	6	24	38	44	54	9	33	52	60	74	12	41	65	74	92	16	48	77	87	108	19	51	83	94	117	20	55	89	101	125

Table B8. Scalar Extremes (m/sec) at Wallops Island

	30 KM					35 KM					40 KM					45 KM					50 KM					55 KM					60 KM				
MO.	VECTOR		PERCEN.			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT		
	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1
JAN	18	20	41	46	56	28	26	57	63	76	37	30	69	76	90	51	32	84	93	108	59	35	96	105	121	63	32	96	104	119	71	31	102	110	125
FEB	18	23	40	45	54	31	25	59	66	78	40	33	76	84	100	52	34	87	96	111	62	32	93	103	118	66	30	96	104	118	70	36	107	116	133
MAR	12	14	28	32	38	26	21	48	53	63	35	25	62	68	79	42	26	68	75	87	42	26	69	75	88	41	24	66	72	83	43	29	73	80	94
APR	9	8	18	21	25	15	13	29	33	39	19	15	34	38	46	23	18	35	43	48	11	18	32	36	44	11	17	31	36	43	8	20	32	37	46
MAY	1	6	10	11	14	1	8	12	14	17	5	8	15	17	21	10	11	20	23	29	10	10	26	29	34	20	11	31	34	40	24	15	39	43	50
JUN	11	5	20	18	20	16	6	22	23	26	24	8	32	34	38	30	9	38	41	44	36	10	40	43	50	45	12	57	60	69	52	14	66	71	77
JUL	14	4	22	23	25	23	4	27	29	31	31	6	37	39	42	41	7	47	49	52	46	10	56	58	64	55	12	67	70	76	59	17	75	80	88
AUG	15	4	20	21	24	19	6	25	27	30	24	7	31	33	37	32	11	43	46	52	34	12	46	49	55	36	15	52	56	63	37	23	62	67	78
SEP	6	3	11	13	15	5	6	12	14	17	8	8	17	19	23	10	11	22	25	30	8	13	23	26	32	6	15	25	29	36	1	19	30	34	42
OCT	11	11	24	27	32	20	16	38	42	50	27	19	47	52	61	30	21	51	57	72	49	24	74	80	91	56	24	81	87	99	55	25	81	88	100
NOV	21	15	37	41	48	37	17	55	59	67	51	18	70	74	83	72	22	94	99	110	88	25	113	119	131	95	27	122	129	142	85	31	117	125	140
DEC	30	17	48	53	61	53	22	75	80	90	69	21	90	95	105	85	25	109	115	127	92	28	124	127	140	94	32	126	134	149	92	34	126	134	150
ANN	6	19	31	35	44	12	28	47	54	66	15	37	61	69	85	23	40	78	86	106	22	52	86	97	120	22	36	92	104	129	19	54	94	107	132

Table B9. Scalar Extremes (m/sec) at Primrose Lake

	30 KM					35 KM					40 KM					45 KM					50 KM					55 KM					60 KM				
MO.	VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT		
	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1
JAN	23	34	62	70	86	25	37	67	76	92	30	40	75	85	103	34	46	86	97	118	30	51	90	102	125	31	50	90	102	125	26	35	66	75	91
FEB	19	22	44	50	60	23	28	56	62	75	36	33	72	81	96	50	39	91	101	119	56	54	115	128	154	54	47	104	116	138	38	43	86	97	116
MAR	8	17	29	33	41	10	23	39	44	54	12	31	51	58	71	11	37	58	66	82	22	35	63	71	87	26	36	68	76	93	35	33	71	79	95
APR	4	11	17	20	25	1	12	19	21	27	3	15	23	26	32	7	17	27	31	39	9	17	31	35	43	9	22	36	41	51	12	23	40	45	56
MAY	9	6	15	17	20	9	7	17	19	22	10	8	19	21	26	9	9	20	22	27	11	12	25	28	34	18	15	34	38	45	25	15	41	44	51
JUN	11	3	14	15	17	14	5	19	21	23	19	4	24	25	27	22	7	29	31	35	30	8	38	41	45	36	13	49	52	59	44	12	56	60	66
JUL	13	4	17	18	20	17	7	25	27	31	23	6	31	33	37	29	10	39	42	46	39	15	55	59	66	47	12	58	62	67	60	16	76	81	88
AUG	6	5	12	13	16	9	7	17	19	23	13	10	23	26	31	16	10	27	30	35	25	12	37	40	46	33	18	52	57	66	44	25	70	77	89
SEP	8	8	17	19	23	10	11	22	25	30	13	11	25	28	34	16	13	30	33	40	17	14	32	36	42	14	19	35	40	48	13	22	38	44	53
OCT	13	11	24	27	33	20	14	35	39	46	29	15	45	49	57	37	17	54	58	66	40	18	58	63	72	39	25	66	72	84	37	28	67	74	87
NOV	9	18	30	34	42	14	20	37	42	51	21	22	46	52	62	30	27	59	65	77	33	31	67	75	90	34	34	72	80	96	31	35	70	78	94
DEC	31	22	54	59	69	35	30	68	75	89	42	35	80	89	106	44	38	85	95	112	44	40	87	97	115	38	41	84	94	113	41	44	89	100	121
ANN	6	21	34	38	48	8	26	41	47	58	12	31	51	58	72	15	37	61	69	86	12	43	67	76	94	13	45	71	81	101	10	46	72	82	101

Table B10. Scalar Extremes (m/sec) at Fort Churchill

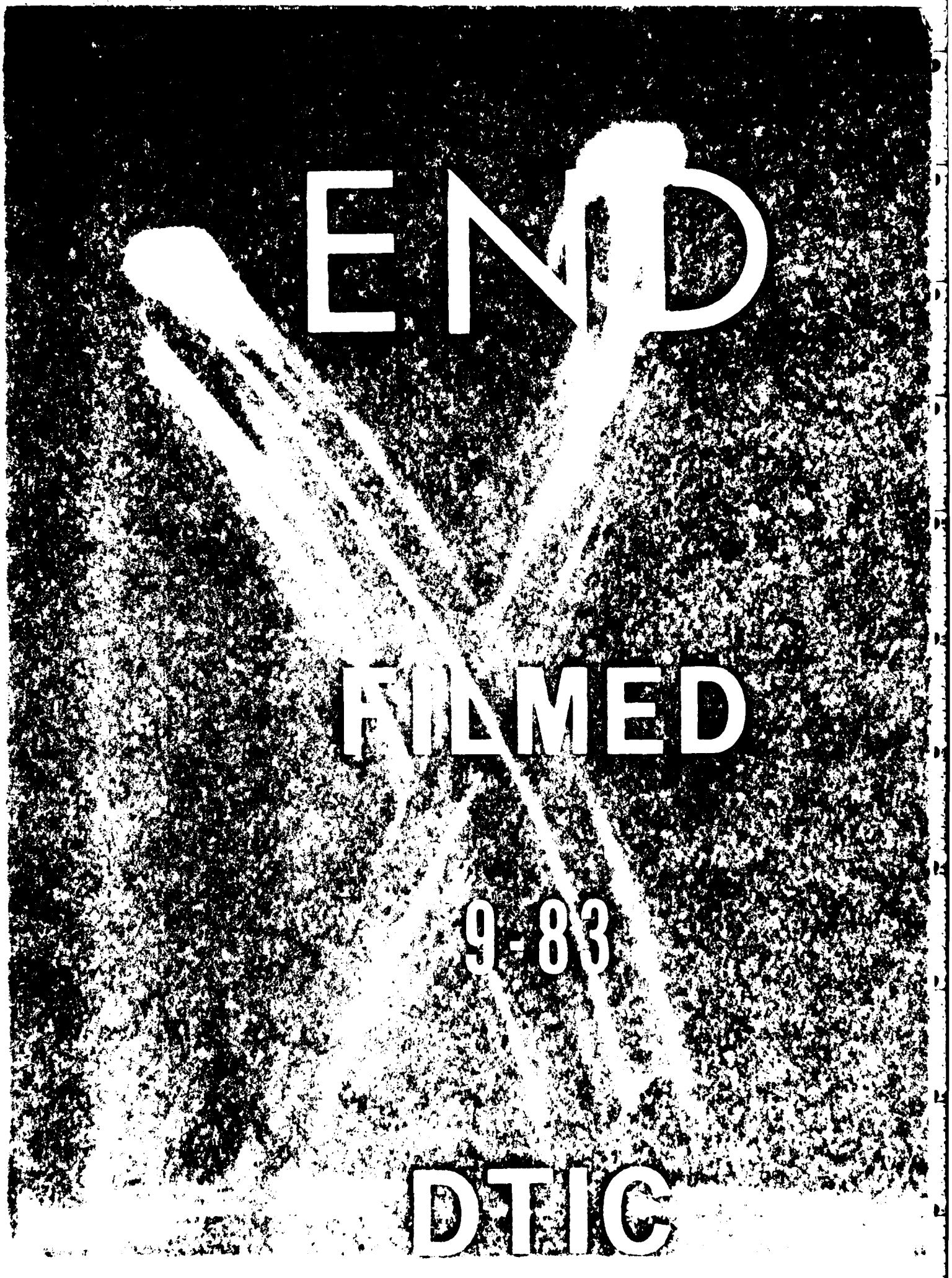
	30 KM					35 KM					40 KM					45 KM					50 KM					55 KM					60 KM				
MO.	VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT		
	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1
JAN	27	36	69	77	94	27	41	74	84	102	33	46	85	96	117	35	54	97	110	134	38	58	105	118	145	35	51	93	105	128	30	41	77	87	106
FEB	25	29	58	65	78	28	32	64	72	86	31	36	72	80	97	41	40	84	94	113	48	44	96	107	128	47	45	96	107	128	47	38	88	97	115
MAR	10	18	31	35	43	10	21	36	41	50	11	27	45	51	63	15	32	53	61	75	23	33	61	68	83	26	33	63	71	86	35	33	71	80	95
APR	5	9	16	18	23	3	12	19	21	26	2	13	21	24	30	9	15	27	31	38	11	18	32	36	44	11	20	35	40	49	11	22	37	42	52
MAY	7	5	13	14	17	8	7	15	17	20	7	8	16	18	22	7	8	17	19	23	10	12	24	27	33	16	14	30	34	40	18	15	35	39	46
JUN	11	3	14	15	17	14	5	19	20	23	16	5	21	23	25	21	6	27	29	32	35	8	43	44	47	33	12	44	48	53	39	13	52	55	61
JUL	9	3	12	13	15	14	4	18	19	21	18	4	22	23	26	23	6	29	31	34	30	9	39	42	46	36	9	46	48	53	45	13	58	62	68
AUG	4	5	9	11	13	6	6	12	14	17	6	6	13	15	18	10	10	21	23	28	14	10	25	27	32	20	12	33	37	42	26	17	44	49	57
SEP	7	6	14	16	19	9	9	19	21	25	13	10	24	27	32	17	12	30	33	39	17	14	32	36	43	15	16	33	37	44	13	17	33	38	46
OCT	16	11	28	31	36	22	13	36	40	46	31	15	46	50	57	40	17	57	62	70	46	20	67	72	82	42	22	65	71	82	42	25	68	74	86
NOV	17	19	38	43	52	25	23	50	55	66	31	24	57	63	75	40	28	69	76	89	45	33	80	88	104	40	35	78	87	103	44	35	81	89	106
DEC	37	25	63	70	82	40	29	71	79	92	44	34	80	89	105	51	37	90	100	117	50	40	93	103	121	45	40	89	99	118	48	40	91	101	119
ANN	13	24	42	48	58	15	28	48	55	67	18	32	56	64	78	23	38	67	76	93	25	42	68	77	95	22	43	74	84	103	22	45	76	87	107

Table B11. Scalar Extremes (m/sec) at Poker Flats

	30 KM					35 KM					40 KM					45 KM					50 KM					55 KM					60 KM				
MO.	VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT		
	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1
JAN	18	32	56	63	78	23	40	70	79	97	29	48	85	97	118	33	54	95	108	132	31	56	97	110	135	26	48	83	94	116	11	60	93	106	132
FEB	21	26	51	57	69	22	30	57	64	78	27	32	63	71	86	33	36	72	81	98	36	41	81	91	110	34	46	86	97	118	21	38	67	76	93
MAR	10	20	34	39	47	12	23	40	45	56	15	27	47	54	66	17	33	57	64	79	18	32	56	63	77	15	30	51	58	72	11	28	46	53	65
APR	5	9	16	18	22	6	12	21	24	29	5	18	26	30	37	1	16	28	32	40	2	21	32	36	45	6	23	37	42	52	9	18	31	35	43
MAY	7	7	14	16	20	7	7	15	17	21	8	8	17	19	22	9	10	21	23	28	11	12	24	28	33	19	15	35	39	46	25	15	41	44	52
JUN	10	4	14	16	18	12	7	20	22	25	15	6	21	23	26	19	9	28	30	34	26	10	37	40	45	32	15	47	51	59	36	18	55	60	69
JUL	10	3	13	14	16	12	3	16	17	18	14	4	18	20	22	20	5	26	27	29	26	7	34	37	39	32	12	44	47	53	43	10	52	56	61
AUG	3	4	8	9	11	3	5	9	11	13	4	6	12	13	16	6	9	16	18	22	9	11	21	24	29	16	15	32	36	43	22	18	42	47	55
SEP	6	7	14	16	20	8	8	17	19	23	13	8	22	24	28	15	11	27	30	35	16	14	32	36	42	16	15	33	36	43	15	20	38	43	52
OCT	17	14	31	35	41	22	16	38	42	50	29	17	47	52	60	37	18	55	60	68	37	27	66	72	85	35	30	67	75	89	25	25	53	59	71
NOV	17	18	37	42	50	24	21	47	52	62	28	21	50	55	65	32	31	67	74	89	42	33	77	85	100	35	43	83	94	113	30	51	90	102	124
DEC	41	24	65	71	82	51	31	83	91	105	57	40	99	109	127	49	43	96	106	127	42	40	85	95	114	29	43	78	89	108	23	49	82	94	115
ANN	7	22	36	41	51	9	27	44	51	63	12	32	52	60	74	13	36	58	66	82	12	38	61	70	86	7	40	62	71	87	6	41	64	73	90

Table B12. Scalar Extremes (m/sec) at Thule

	30 KM					35 KM					40 KM					45 KM					50 KM					55 KM					60 KM				
MO.	VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT			VECTOR		PERCENT		
	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1	Mn	σ	10	5	1
JAN	24	36	66	74	90	29	43	79	89	108	31	48	87	98	120	23	53	89	101	124	28	62	103	117	145	30	60	102	116	143	14	53	84	95	118
FEB	28	31	63	71	85	28	34	66	75	90	29	38	72	81	98	25	43	75	85	104	20	41	70	80	98	19	44	74	84	104	16	41	68	77	95
MAR	17	25	46	52	63	21	28	53	59	72	23	33	61	68	83	18	35	60	68	83	15	33	55	63	77	9	33	52	59	73	9	32	51	58	71
APR	4	11	18	21	26	4	11	18	21	26	4	13	21	24	29	5	13	22	25	31	5	16	25	29	35	7	14	24	28	34	8	16	27	31	39
MAY	6	4	10	11	13	6	6	12	14	17	8	10	19	21	26	11	17	32	36	44	16	19	38	42	51	19	26	49	55	67	28	12	40	43	49
JUN	6	4	10	12	14	7	5	12	14	16	9	6	15	17	20	15	9	25	27	31	17	10	27	30	35	22	14	37	41	47	27	13	40	44	50
JUL	6	3	10	11	13	7	4	12	13	15	9	6	15	17	20	14	7	21	23	26	18	6	24	25	29	22	8	30	33	37	25	9	34	36	41
AUG	4	5	10	11	13	4	6	11	13	16	6	7	14	16	19	9	9	19	21	25	12	10	22	25	29	13	14	29	33	40	16	15	33	37	44
SEP	4	7	12	14	17	7	8	17	19	23	11	11	23	25	31	15	11	26	29	34	15	13	30	33	40	19	15	31	38	45	15	23	42	47	58
OCT	12	11	25	28	33	12	14	28	31	37	14	15	31	35	42	17	17	36	40	48	19	22	43	49	59	17	27	48	54	66	17	27	49	56	68
NOV	28	27	57	63	76	30	32	66	74	89	32	36	73	82	99	36	42	83	94	113	36	42	83	94	113	33	46	86	97	119	36	52	96	108	132
DEC	15	28	49	55	68	20	35	61	70	85	17	46	74	84	104	13	51	80	92	113	9	54	83	94	117	8	56	86	98	121	10	56	87	99	123
ANN	8	24	39	44	55	9	28	45	51	63	10	32	51	58	72	7	35	55	63	78	6	37	58	66	82	4	40	61	69	86	1	39	60	68	85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AD-A132 019 WIND-SPEED EXTREMES IN THE NORTHERN HEMISPHERE 30 THROUGH 60 KM(U) AIR FORCE GEOPHYSICS LAB HANSCOM AFB MA A J KANTOR ET AL. 02 FEB 83 AFGL-TR-83-0029 3/3

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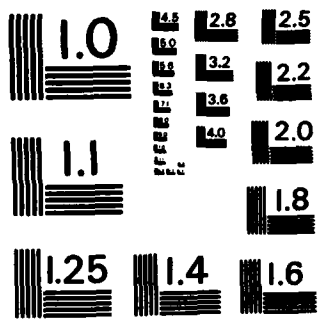

MICROCOPY RESOLUTION TEST CHART
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INFORMATION

AFGL-TR-83-0029
ENVIRONMENTAL RESEARCH PAPERS, NO. 823
2 FEBRUARY 1983

WIND-SPEED EXTREMES IN THE NORTHERN HEMISPHERE, 30 THROUGH 60 KM

Arthur J. Kantor
Eugene A. Bertoni

Errata

Change captions for Figures A25, A58 and A76 to read "1-percent" instead of "10-percent".

Change captions for Figures A27, A60 and A78 to read "10-percent" instead of "1-percent".

AIR FORCE GEOPHYSICS LABORATORY
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